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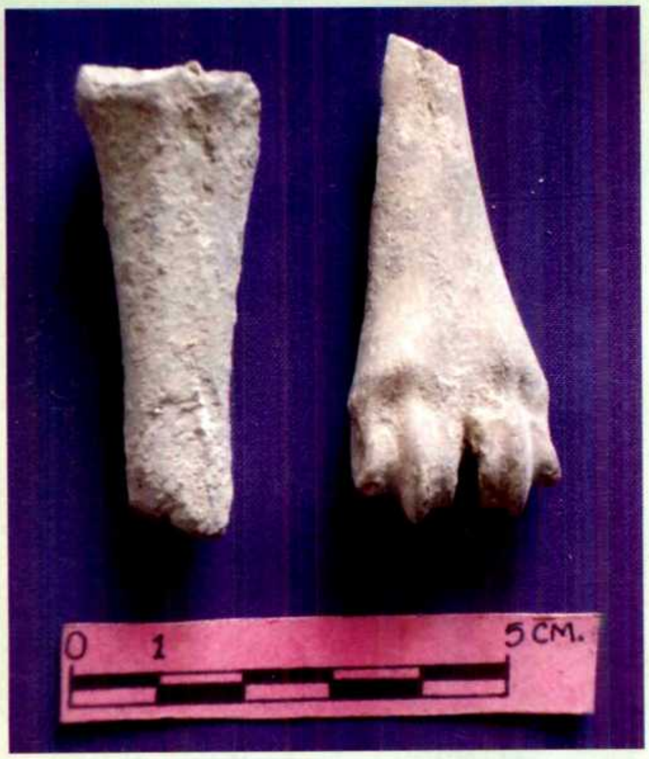

Fig. 4: Left: proximal portion of metatarsal of *Capra hircus* from Tarkhanewala Dera. Right: A distal portion of metacarpal of *Ovis aries* with fused trochlea from Tarkhanewala Dera

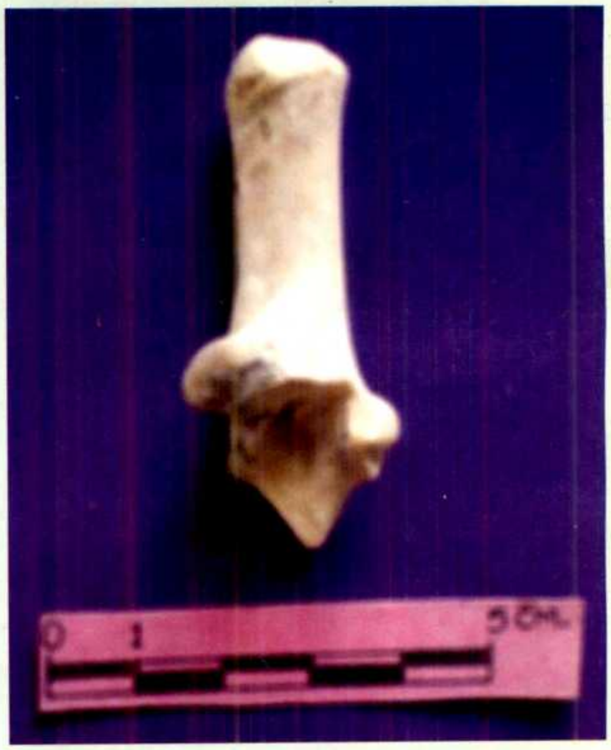

Fig. 8: Complete calcaneum of *Capra hircus* from Chak 86

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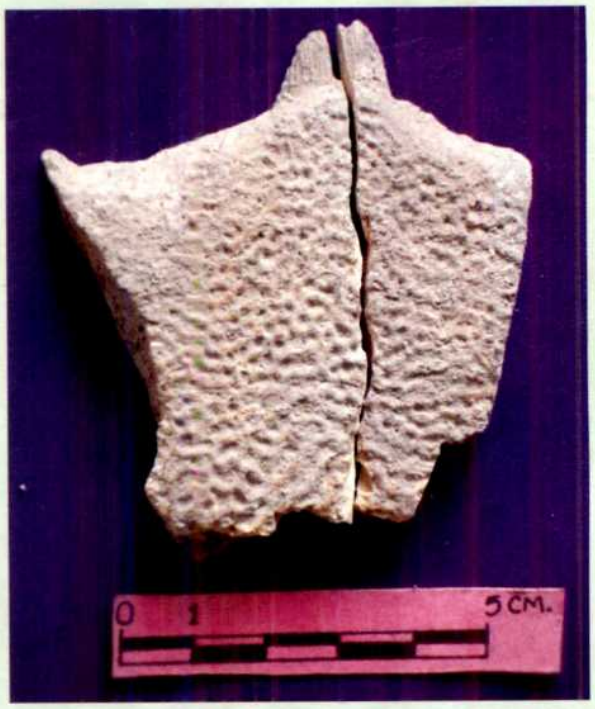

Fig. 5: Plastron of turtle (*Trionyx gangeticus*) from Tarkhanewala Dera

Arati Deshpande-Mukherjee, P.K. Trivedi and J.K. Patnaik, *Man and Environment* XXXIII (1): 51-57 [2008].
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Man and Environment

Journal of the Indian Society for Prehistoric and Quaternary Studies

Editor: V.N. Misra

Joint Editors: P.P. Joglekar
Shanti Pappu

Editorial

We are happy to bring out this issue as per schedule. As in the case of our previous issues this one includes a range of papers and adopts a multidisciplinary approach towards representing Indian archaeological research. We begin with the text of the Professor H.D. Sankalia lecture, delivered by Prof. V.H. Sonawane at the Annual Conference of the Society held at Raipur (1-4 December 2007). He presents a review of rock art research in India, examines present trends and identifies problems to be taken up in the future.

Sheila Mishra presents a comprehensive overview of archaeological evidence of the Lower Palaeolithic in India, with a special emphasis on recent findings. Shanti Pappu presents new information on Robert Bruce Foote, based on her ongoing research into his life and work.

We have four articles related to Harappan studies. L.S. Rao has discussed the evidence of terracotta toy cart frame models recovered at Bhirrana (District Fātehabad, Haryana); and discusses the evolution of Harappan bullock cart designs. Michel Danino's article is an attempt to examine Harappan units of measurements and relate these to the system used in ancient India. R. Balasubramaniam of I.I.T., Kanpur examines the Harappan standard of length measurement. He suggests that the unit (*angulam*) continued to be used even during the manufacture of the Delhi Iron Pillar. Arati Deshpande-Mukherjee and others have presented the findings of faunal studies from two sites in the Ghaggar Valley, viz. Tarkhanewala Dera and Chak 86, Ganganagar district, Rajasthan.

Human skeletal studies occupy very important place in interpreting the past. Veena Mushrif-Tripathi and her colleagues have presented a report on investigations carried out on two skeletons recovered from the PGW level at the site of Abhaipur (U.P.). It is interesting to note that the younger individual exhibits evidence of metabolic disorders.

Shahnaj Husne Jahan discusses questions related to the evolution of the State in Bengal, from the lineage-based society of the pre-Mauryan era to the post-Mauryan era.

During the Annual Conference of the Society held at Raipur, Rammathot Khongreiwo, presented a paper on ethnoarchaeological investigations as related to the megalithic tradition of the Tangkhul Nagas of Manipur. This paper was selected for the Malti Nagar Ethnoarchaeology Award 2007, and is published in this volume.

The publication of this Journal has been financially supported by the Indian Council of Historical Research (ICHR) and the Archaeological Survey of India (ASI). The responsibility for the facts stated, opinions expressed, or conclusions reached is entirely that of the contributors of the articles. The ICHR, ASI and the Indian Society for Prehistoric and Quaternary Studies accept no responsibility for them.

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Cover: Human skull from Abhaipur, U.P.

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Rock Art of India: A Historical Perspective*

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I am beholden to the Executive Committee of the Indian Society for Prehistoric and Quaternary Studies for electing me to deliver the prestigious Prof. H.D. Sankalia Memorial Lecture for the Society's 35th Annual Conference here at Raipur. Friends, you are all aware that the Prof. H.D. Sankalia Memorial Lecture has been delivered up till now by great stalwarts in the field of archaeology, who are known for their contribution and are reputed scholars. I know for certain that there are many scholars more qualified and distinguished, definitely being a better choice to deliver this talk. I sincerely, believe that the Executive Committee Members have done me this honour more in recognition of the contributions of the Institution to which I belong with my illustrious predecessors, Prof. B. Subbarao, Prof. R.N. Mehta, Prof. S.C. Malik and Prof. K.T.M. Hegde. Compared to them, my contribution in the field of archaeology is quite modest. Yet with all my limitations I would like to take this opportunity to present before this august body of scholars, the present status of rock art research in India. Although this topic forms an important record of the archaic expression of human presence, it is treated as something apart and has been neglected by archaeologists and historians.

Amongst my few reminiscences of Prof. H.D. Sankalia, I would like to recall the first one, when I met him during the VI Annual Conference of the Indian Archaeological Society held at Kurukshetra in November 1972. It was the first conference which I attended. When I was introduced to him, as hailing from the M.S. University of Baroda, he immediately asked, "Are you the same Sonawane who has written an article on the Mandvi step well inscription at Champaner?" I was taken aback and astonished that he could remember my name and the first article I published in the *Journal of the Oriental Institute*. The second time I met him was in 1973, when he came to visit the Champaner excavation. This time the talk was of a more academic nature, but I still remember what he said, "Gujarat has a lot of archaeological potential and if you could continue to work in archaeology you will have a bright future". The prophecy of Professor Sankalia turned into reality, to some extent.

Prof. Sankalia played a vital role in establishing the Archaeology Department at the M.S. University of Baroda. Immediately after the foundation of the M.S. University of Baroda in 1949, the first Vice-Chancellor Smt. Hansaben Mehta approached Prof. Sankalia with a request to take up the chair of archaeology in the university. He declined the offer modestly, and the job was entrusted to Dr. B. Subbarao, and rest of the story is very well known. In fact Prof. B. Subbarao started his field work, by borrowing a camera and other field equipment from the Deccan College, Pune.

For today's talk, I have deliberately selected the topic of Rock Art, which was one of the subjects of Prof. Sankalia's interest. Many of you may be surprised to know that in 1978, Prof. Sankalia published a book on *Pre-Historic Art in India.*

Introduction

Various theories exist as regards the meaning and function of rock art in India. A lot remains to be done as far its proper interpretation is concerned. In a quest to unravel the probable purpose and meaning of rock art, the author has kept in mind that rock art interpretation is highly speculative for there is practically no living tradition of rock art in India. After studying rock art using traditional methods, the shortcomings of interpretations being made are clear. The analysis of these limitations has suggested the need for a new approach. When we face the problem of analysing rock art, the risk of interpreting its meaning and function in a subjective way is very high. Visual art is an expression of human experience. It articulates the artist's concern through form, colour and composition and at the same time communicates with the viewer at different levels resulting in multiple readings. It is this that makes a work of art intriguing and fascinating at the same time. Irrespective of the motivation and purpose of creation, art, more often than not, reflects directly or indirectly the cultural ethos of a society, past or present. A work of art therefore provides interesting data for analysing and understanding the social context of its creation, which would otherwise be completely missed in normal material culture studies. It is this quality of the painting or engraving or of small figurines of portable art objects of the prehistoric period, that makes them unique and valuable in reading the cultural behaviour of past societies (Ajithprasad 2006:15).

All rock art embodiments of semiotic expressions bear great meaning for their authors. In a society devoid of phonetic writings, forms of graphic representation are very meaningful for the preservation and communication of thoughts and ideas. Rock art may also be viewed as a means of communication and symbolism. It certainly reflects aesthetic taste developed by a prehistoric community. Though many of these art forms are highly abstract in their nature, some of them can be regarded as symbolic, while others are rich in descriptive details. Symbols are often considered as material representations of abstract concepts. There are no visually obvious associations between the symbol and the entity which it represents. Typical non-iconic or pre-figurative art is far more likely to be symbolic than their iconic or figurative counterparts. The latter is only symbolic when a depiction of the object refers to an abstract concept (Bednarik 1994: 174b). Therefore, it is preferable to interpret rock art within the context of the host culture and not on the basis of visual similarity with other cultures across space and time, unless an unbroken link can be established. In this context it needs to be mentioned here that it has generally been observed that rock art in almost all parts of the world had many functions. Primarily, rock art had links with shamanism, a fact supported by ethnographic case studies such as in the San community of South Africa (Lewis Williams 2002). Similarly ethnographic case studies from some parts of India reveal that shamanism is a common practice amongst tribes, and even today some of these shamanistic activities lead to creation of images which have spiritual connotations, for e.g. in the Saura community Orissa (Pradhan 2001).

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* Prof. H.D. Sankalia lecture delivered during the Annual Conference of the Society held at Raipur (1-4 December 2007).

It is thus high time for researchers interested in Indian rock art, to look for meaningful interpretations, keeping in view the importance continuity of rock art, in the Indian contest, supported by archaeological, literary, ethnographic and oral traditions.

History of Rock Art Research

Rock paintings in India were first recorded in the course of pioneering discoveries made in 1867 by Archibald Carllyle in the forested region of the Kaimur ranges in Mirzapur district, Uttar Pradesh. These paintings were discovered about twelve years prior to the discovery of the Altamira cave paintings in Spain. Although Carllyle did not publish any account of his discovery, he left his notes with a friend and there were later published by Vincent A. Smith (1906). Carllyle assigned the date of these paintings to the prehistoric period. John Cockburn a contemporary of Carllyle studied these rock paintings systematically and also produced tracings of several of them. Unfortunately he failed to recognize their prehistoric antiquity. In 1899 he published an account of all his discoveries, in which he also compared them with those found in Australia, South Africa, North and South America (Cockburn, 1899). Percy Brown, who visited the painted shelters at Singanpur in Raigarh district Madhya Pradesh in 1914, recognized their importance and included them as prehistoric art in his book on Indian paintings (Brown 1917).

Rock engravings of South India were brought to light after 1892 when F. Fawcett visited Kupgallu in 1892. Fawcett is better known for his discovery of Edakal cave in Kerala (Fawcett 1901). However prior to this, rock bruisings were reported by H. Knox from Bellary district of Karnataka. Subsequently more rock bruisings were reported from this area by F.R. Allchin (1963:161), A. Sundara (1974), K. Paddayya (1968:294-98) and N. Chandramouli (1995).

In 1921, Manoranjan Ghosh brought to light a group of painted rock shelters at Adamgarh near Hoshangabad (Ghosh 1932). In the 1930's, D.H. Gordon tried to tackle the chronological problem of rock art by observing the superimposition of paintings, their style and technological contents. He worked basically on rock paintings of the Panchmarhi in Mahadeo Hills, Central India. Though he could not visualize a long autochthonous development of Indian rock art in its original setting, he was the first antiquarian to write extensively on thematic elements shown in rock paintings. A chapter dealing with rock art in his book became a widely read introduction to rock art in Indian archaeology (Gordon 1958).

Since then, more than 5,000 painted shelters have been reported from various parts of the Indian subcontinent. These spectacular discoveries brought a new momentum to rock art studies. V.S. Wakankar, who recognized its archaeological potential, was the driving force behind these recent large scale discoveries. He discovered several hundred painted rock shelters mainly in central India and attempted a broad survey of rock art sites in the country (Wakankar 1975a; 1987; 1992; Wakankar and Brooks 1976). Wakankar employed appropriate guidelines to determine the chronology of these paintings, based on their themes, style, superimpositions and the archaeological context in a historical perspective. The most outstanding contribution of Wakankar to the field of rock art was the discovery of Bhimbetka in 1957. It is one of the most splendid rock art sites known to the world. The site has now become synonymous with rock art in India and in 2003 was recognised as a World Heritage Site. Among prominent contemporary researchers of rock art are S.K. Pandey (1975; 1993), Shankar Tiwari (1975), Jagdish Gupta (1967), R.K. Varma (1964), A. Sundara (1984), Neumayer (1983; 1993) and Mathpal (1984; 1995). These scholars have contributed to develop a possible link between rock art and archaeological data, in order to ascertain its antiquity and historical relevance.

Rock art research in India, on the basis of where we stand now, lacks a scientific or technological base. However, strides are being made by several scholars to develop a multi-disciplinary approach for systematic investigation focusing on regional studies. The most active among these are Giriraj Kumar of Dayalbagh Institute, Agra; Sadasiba Pradhan of Utkal University, Bhuvaneshwar; Somnath Chakraverty of Calcutta University, Kolkata; K. Rajan and N. Chandramouli of Pondicherry University, Pondicherry; K.K Chakravarty, G.L. Badam and B.L. Malla of Indira Gandhi National Centre for the Arts, New Delhi, K.K. Basa of Indira Gandhi Rashtriya Manav Sangrahalaya, Bhopal; R.C. Agrawal, B.R. Mani, S.B. Ota, K.K. Muhammad, M. Joseph, Arakhita Pradhan, V.N. Prabhakar, Bhuvan Vikrama of the Archaeological Survey

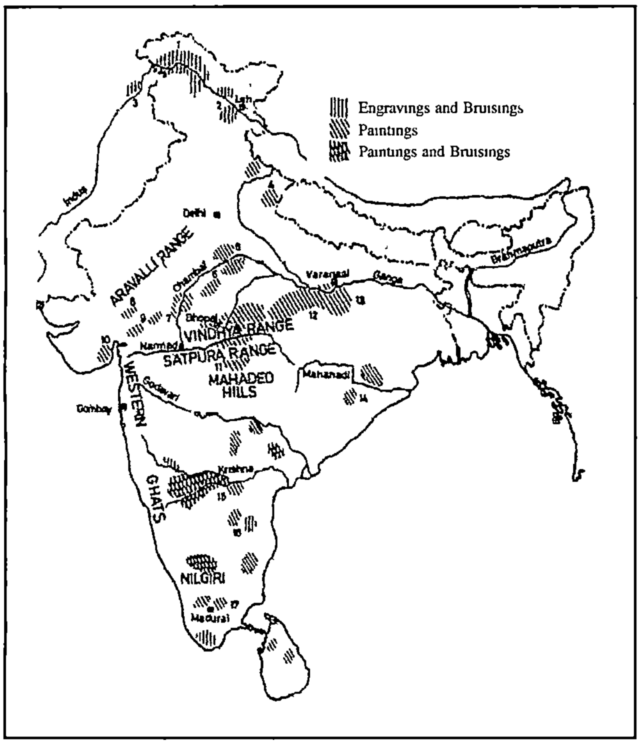

Fig. 1: Map showing the major rock art regions of India

of India, Rakesh Tewari of the U.P. State Archaeological Organization, Lucknow (Tewari 1990); J.N. Pal of Allahabad University and Morarilal Sharma of Government P.G. College, Kotputali. Besides these, R.K.Pancholi, A.K. Prasad, Riza Abbas, M.C. Srivastava, Urmi Ghosh, Meenakshi Pathak, Bharti Shroti are among the several upcoming young scholars involved in serious research of various aspects of the study of rock art. Among foreign scholars of the post-independence period R.R.R. Brooks (U.S.A), Erwin Neumayer (Austria), R.G. Bednarik (Australia) and Michael Lorblanchet (France) are prominent amongst those who have made substantial contributions to promote rock art research in India.

Distribution and Nature of Rock Art

The vast corpus of rock art in India is confined to sandstone and granite pockets, stretching from the southern parts of Kerala to the high altitudes of the Ladakh and Zanskar valleys in the north; and from Gujarat in the west to Assam and Manipur in the east (Fig. 1). However, the largest concentration is confined to the Vindhyan ranges of Madhya Pradesh, and its Kaimur extension into Uttar Pradesh. Equally important paintings and engravings were reported from Southern Deccan in the extensive granite wilderness of the Krishna-Tungabhadra Doab.

In the sandstone region of Central India, rock paintings were found on the walls or ceilings of shelters as well as an cliff wall cavities or any other suitable place where they could withstand the effects of different weathering agencies. Bhimbetka, Jaora, Kathotia, Firengi, Gupha Maser, Lakhajoar, Kharwai, Adamgarh and Panchmarhi are the important localities representing rock art sites of this nuclear region. The geomorphological setting of the rock art sites of South India is strikingly different from that of Central India. To a large extent, rock art of South India is represented by rock bruising with examples of paintings as well. The paintings are generally found on the shelter walls of projected ceiling hoods and invariably in niches developed by natural weathering. Among the several South Indian sites, the better known are Kupgallu, Maski, Piklihal, Edakal cave, Tekkalakota and Badami.

Rock paintings are found in various states of preservation depending upon their location. Many of these paintings have partially faded away because of the destructive action of natural and human agencies. The paintings on granite surfaces are not very durable. As a result only those paintings which are located in well protected spots or hollows, are well preserved. Though most paintings were monochrome, there were instances of bichrome and polychrome drawings as well. The great mass of rock paintings show a predilection towards several shades of red ranging from rather dark violet to yellowish brick-red. The red pigment, in most cases, was acquired from red haematite nodules, called '*geru*' containing iron oxide found in lateritic formations. White was the next colour in terms of frequency of usage. It was obtained either from calcium carbonate nodules (*kankar*) or from kaoline clayey deposits. Occasionally some of the earliest paintings were depicted in green and yellow, employing mineralized chalcedony. The authors of these paintings exploited natural resources to be used as pigments available within the proximity of the rock art sites. At places, rock floors or shelters show scooped out circular depressions often retaining traces of paints. Such 'cup-marks' were intended for preparing colours for painting.

Unfortunately no serious attempts have been made so far by scholars to use various scientific methods for studying these pigments. It has been proposed that the artists diluted the colour in water or by a temporal method. The use of fibrous materials derived from plants cannot be ruled out. A dry colour technique using crayons is noted as well as use of stencils or a spray technique. Engravings or carvings better specified as bruisings or petroglyphs are also seen. In the Indian context, bruisings constitute the second important component of rock art. Bruisings were executed either by rubbing or pecking the rough granite surface. As a result the intended picture in white, appears clearly against the dull brown background of the rock. Such bruised works of art can withstand all weathering agencies, even on unprotected rock surfaces, and survive for a prolonged period of time.

Besides rock paintings and bruisings, portable artefacts carved on stone, bone and ostrich egg shell pieces, though very meagre in number, form an additional source of information. These early forms of applied art reflecting an aesthetic taste, are of extreme importance in the absence of absolute dates.

Chronology

Although rock art was discovered in India quite early, the knowledge of its existence had little influence on archaeological research until the last two or three decades (Mathpal 1992). Recent attempts to find chronological indicators of rock art from associated artefacts through excavations, have helped to some extent in establishing the antiquity of some of these paintings. Such paintings, in the absence of absolute chronometric dating, are taken into consideration to formulate tentative stylistic criteria for establishing a chronological sequence of Indian rock art, as a broad based working hypothesis. Besides, the rock paintings themselves are useful in establishing a relative chronology on the basis of their thematic content, superimposition, style and context. Therefore, one may use these different parameters for chrono-cultural classification of our vast and diverse rock art treasures.

In many shelters, rock pictures are very often found painted or superimposed one over the other. In such cases, building up a relative chronology of these pictures becomes quite easy by observing patterns of overlapping of paints. Here, one has to note stylistic features of the successive paintings as well as the use of colour. Thus, by correlating relative chronology with these features, one can unravel the age or cultural phase of the rock pictures effectively. Indian rock pictures are numerous and extremely narrative, with diverse details. A thematic analysis can therefore, establish a wide ranging picture of the technological and social conditions under which they were created. The correlation of such paintings with archaeological data will bring us closer to a technologically well defined periodization of Indian history. For convenience the pictures drawn before the introduction of the Brahmi script, are considered as prehistoric and are divided into two distinct groups: - those of hunter gatherers and those of agriculturists, representing, food gathering and food producing societies' respectively. Pictures lacking domesticated animals or those which lack metal weapons, obviously belong to a class of society which did not possess these innovations. Such early pictures show that hunter-gatherer groups manufactured microlithic barbed weapons, like spears and arrows, constituting microlithic technology current in India from the Upper Palaeolithic to the Mesolithic period.

Unlike the pictures of hunters and gatherers, the paintings of people practicing animal domestication depict humped cattle, goat and sheep. In this category we also find yoked oxen, two-wheeled bullock carts and many other features of an agricultural settled life style (Neumayer 1991). In central India, rock art often resembles Chalcolithic pottery designs found on Malwa ware. None of the South Indian bruisings can be compared with any of the Mesolithic paintings. It seems that all the bruisings were done once agriculture and animal domestication were well established. The main subject of bruisings and paintings of this period are cattle. On the contrary, rock paintings of historic periods are characterized by the appearance of inscriptions along with painted compositions. The presence of Brahmi and Shanka writings, besides depiction of religious icons and symbols of Brahmanical and Buddhist faiths, war scenes or processions showing horse and elephant riders armed with swords and shields and mythological and contemporary narrations, belong to the historic periods. Very often, there is a predilection for the use of white colour in later paintings of this period.

The periodization of Indian rock paintings is thus supported by a chronological framework based on the observation of overlapping rock pictures belonging to different stylistic groups. The dating is further based on thematic analysis of pictures showing patterns of subsistence, tool technology and technological innovations. Unfortunately, unlike parts of Europe, datable finds such as carved or engraved artefacts from archaeological strata' are lacking in India. These could have enabled the comparison of rock paintings with designs found on such artefacts. Most rock art around the world has also not been securely dated; however, with the advent of AMS (Accelerator Mass Spectrometry) dating through pigment analysis, at least a few paintings of selected areas may be dated.

Earliest Rock Art Expressions

In the Indian context, the antiquity of rock art dates back to the Upper Palaeolithic period. However evidence of artistic expression begins with the haematite and quartz crystals found in Acheulian deposits of the Lower Palaeolithic period. One such haematite specimen was found at locality V at Hungsi (Karnataka) and bears a worn facet with distinctive stratiation marks suggesting that it had been used as a crayon to colour or mark a rock surface (Bednarik 1990). The excavator believes that these haematite nodules have been brought into the spot from some distance since this material does not occur in its natural state around the site. He further states that these red ochre nodules must have been used for body decoration or other purposes (Paddayya 1984:356). Interesting evidence also comes from Singi Talav (Rajasthan) where, from the base of the Lower Palaeolithic deposit, six small quartz crystals were recovered. They measure 7 to 25 mm in length and are therefore, too small to have been used as tools and were almost entirely unmodified. Like the Hungsi haematite nodules, they were brought to the site deliberately and were apparently collected for their visual qualities (Bednarik 1994: 356-357a). Although regarded as a tentative inference, one cannot rule out the possible functional reality involving an aesthetic sense amongst our early ancestors.

Such an early beginning for rock art is further substantiated by the discovery of petroglyphs found at the site of Bhimbetka. Bednarik has reported two petroglyphs from the excavated Auditorium rock shelter (III-F 24). These consist of a large circular scooped-out cupule and a pecked meandering line running to its periphery. Their stratigraphic position within the habitation deposit suggests that they were made during the Acheulian period. He considers them to be the oldest known rock art in the world (Bednarik 1994, 356-57a; Bednarik *et al.* 1991:34). More recently Giriraj Kumar has reported nearly 500 cupules at Daraki-Chattan near Bhanpura in the Chambal valley and assigned them to the Palaeolithic period based on the occurrence of Acheulian and Middle Palaeolithic implements on the same cave floor (Kumar 1996).

It is quite possible to infer that some of the symmetrically formed and beautiful looking bifaces often encountered in the lithic assemblages of the Lower Paleolithic period reflect the artistic ability of the tool makers and served as either art or religious objects. Two such circular discoid stone artefacts of non-utilitarian character, one found from Bhimberka III F-24 and the other from Maihar (Madhya Pradesh), have provided possible relevant evidence in this regard (Bednarik 1992). The anthropomorphs forming part of the Copper Hoards and numerous ethnographic analogies would corroborate this assumption.

Upper Palaeolithic Phase

Though there is no dispute of the historicity of Mesolithic rock paintings, it is quite likely, (as Wakankar believed) that some of the early paintings done in green colour, do belong to the Upper Palaeolithic phase. The possible basis for this supposition is that facetted green earth (what he called terra verta) has been found in Upper Palaeolithic deposits at an excavated rock shelters (III A-24) at Bhimbetka (Wakankar 1975b: 19; 1983). However, there is a dispute about the chronological position of the green paintings. Some researchers feel otherwise and have remarked that green paintings were preceeded by red paintings (Tyagi 1992, 304). Here, emphasis has to be given to the style rather than the colour of the paintings. Although red is most frequently used, in paintings of the earliest style in the region around Bhopal, there are instances of paintings drawn in green and a few even in yellow. These paintings show a strictly codified repertoire in their style and use of space, as though they were a part of a widely understood communication system. They are distinguished from later paintings by a high degree of craftsmanship and a characteristic uniformity. The quality of application of the pigment in the form of controlled and fine lines seen in these early paintings symbolizes the beginning of known surviving rock art in India. The Upper Palaeolithic paintings can be broadly subdivided into two phases, pre-figurative or non-iconic and figurative or iconic, on the basis of their thematic styles.

A closer inspection of global rock art sites shows that pre-figurative rock art precedes figurative ones in most cases. Pre-figurative art consists of a fairly restricted range of elements or form constants, which are found in numerous variants or which may be built into elaborate "mazes" or geometric arrangements. The basic element of all archaic rock art is dominated by curvilinear motifs like concentric circles, spirals with variations, and intermediate forms including geometric motifs (Bednarik 1994b). Indian rock art is no exception to this widely accepted phenomenon. Paintings consisting of geometric patterns or intricate designs form the most conspicuous feature of this earlier style (Neumayer 1993: 43). In several paintings these intricate designs often identified as 'Labyrinthian' are composed of rhombic meanders and honeycomb patterns along with their multiple derivatives and cover a large space of the virgin rock shelter surface (Fig. 2). None of these are superimposed on any earlier paintings (Tyagi 1992: 304-06).

Chronologically, pre-figurative or non-iconic symbolic motifs are followed by figurative or iconic representations. This has been attested at some places where the 'S' type of green paintings depicting dynamic dancing human figures have been observed superimposed on intricate designs of earlier paintings drawn in red ochre (Fig. 3). The striking feature of this later style consists of human forms which are transformed to perfect 'S' shapes (Fig. 4). These paintings do not depict any activities except dancing and hunting scenes and are known for their vigorous dynamism which is unparallel in later rock art (Fig. 5). In this regard, the authenticity of a green painting depicting an ostrich noticed recently by S.K. Pandey at one of the sites in Central India might resolve the earlier controversy (personal communication, with S.K. Pandey). In several rock shelters intricate designs are found as body decoration on some animal figure (Fig. 6). Here, among other designs, the spiral rhomboid is a recurring motif on the large and uncommon depictions of wild boar, elephant, rhinoceros and deer. These large figures are identified as 'deified animals' (Misra 1985: 120). It seems that this early tradition continued to some extent even during the Mesolithic period, and therefore it sometimes becomes difficult to demarcate these precisely.

Other Forms of Rock Art

Apart from rock paintings, interesting evidence pertaining to ostrich eggshells, bones and stones is present at a few sites of this period. In this regard, an engraved portable artifact of applied art is reported from Patne (Maharashtra). Of several ostrich eggshell pieces recovered from Upper Palaeolithic levels, one had a distinct simple geometric pattern: - a criss-cross hatching, between two parallel lines. A somewhat similar engraved design is also seen on the lower part of the same eggshell fragment (Fig. 7). This has been dated to 25,000 BP based on ^{14}C dates of the ostrich egg shell samples from the same strata (Sali 1974: 157). The authenticity of the

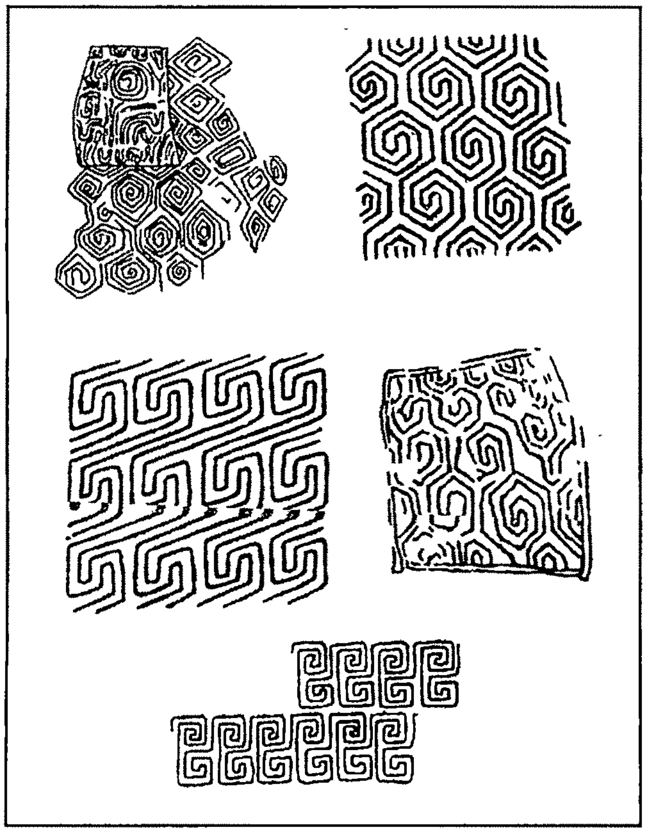

Fig. 2: Pre-figurative rock paintings

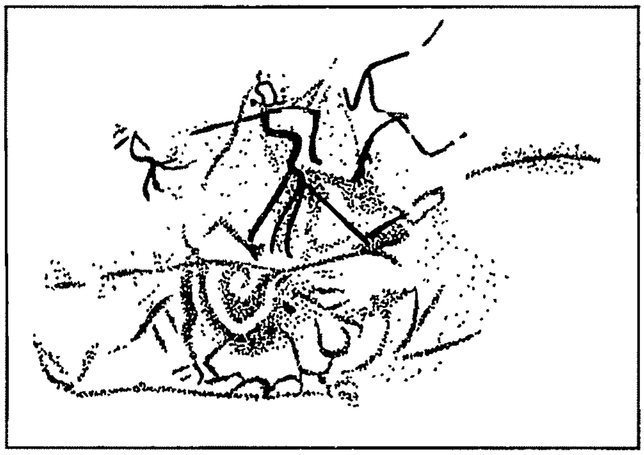

Fig. 3: Red intricate designs superimposed by green dynamic dancing human figures, Jaora

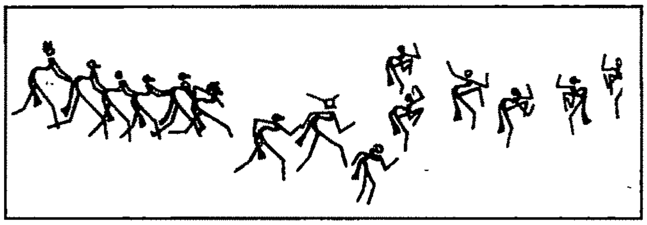

Fig. 4: 'S' shaped dynamic dancing human figures painted in green colour, Lakhajoar

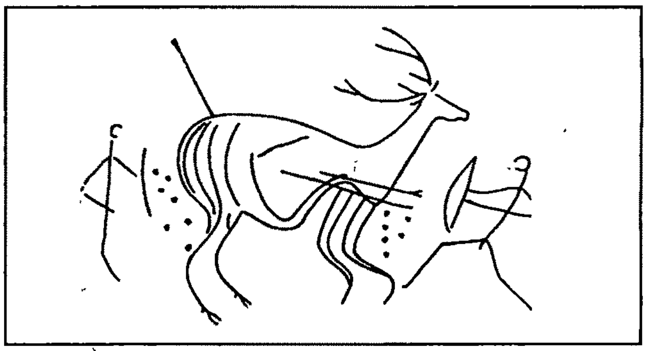

Fig. 5: Hunting Scene, Putli Karar

engraving found on the ostrich egg shell pieces reported from Bhopal, Ramnagar and Chandresal, has been questioned by scholars (Bednarik 1993: 24; 1994: 359a; Neumayer 1990: 27), although they have furnished vary early dates ranging from 40,000 to 25,000 BP (Kumar *et al.* 1988).

Ostrich eggshells were also effectively exploited for making ornamental beads. Two such perforated disc beads were reported from Patne. Two more beads of this category were found at Bhimbetka in Shelter III A-28, excavated by Wakankar. All Palaeolihtic of them were recovered from stratified archaeological deposits of the Upper Palaeolithic. In this context, the recent discovery of an ostrich eggshell bead manufacturing site in the Narmada Valley at Khaparkheda by S.B. Ota and Sheila Mishra is very interesting (Ota: personal communication). Apart from these, barrel shaped bone beads and grooved animal teeth (Bovid) pendants were found from one of the Kurnool caves (Bila Surgam III) of Andhra Pradesh (Murty and Reddy 1975). The Upper Palaeolithic cave site of Muchchatala Chintamanu Gavi has furnished a TL date of C. 19000 BP from where one such bone bead was obtained (Murthy 1974). All these specimens indicate that they were strung together and they constitute the earliest known evidence of ornamentation in India.

In this context, a carved bone artefact recovered from cemented gravel layer III of Lohanda Nala in the Belan valley (Uttar Pradesh) is worth recalling (Fig. 8). The specimen is about 8 cm long, 1.5 to 2.5 cm broad and about 1 cm thick. It generated varied feelings among scholars, as to whether to call it a figure of a mother goddess or an object similar to that of a harpoon (Gupta 1979-80; Bednarik 1993: 34-35). However, it is now regarded as a well made bone harpoon which suffered extensive damage in very coarse sediment matrix. It's presence thus provides cogent evidence of a highly sophisticated tradition of working bone during this period. The stratum in which this artefact was embedded contains evidence of an Upper Palaeolithic blade and burin industry and was dated to 25000 BP, on the basis of ^{14}C dating of fresh water shells (Misra 1977: 49).

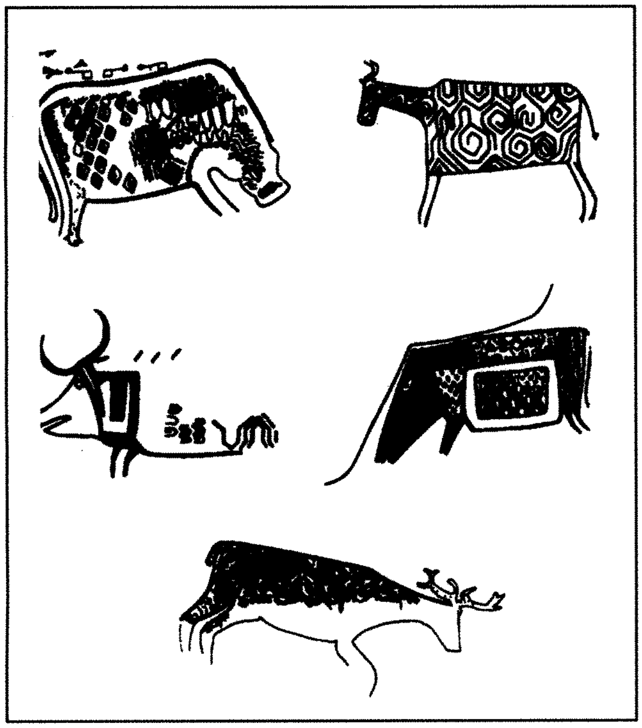

Fig. 6: Intricate designs done as body decoration on animal figures

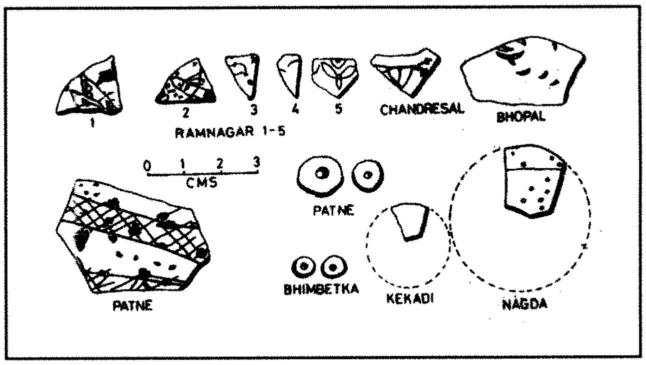

Fig. 7: Decorated ostrich egg-shell objects

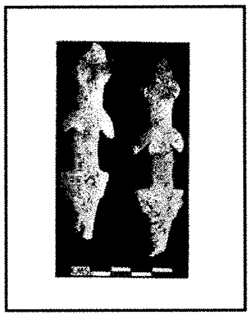

Fig. 8: Bone object, Belan Valley

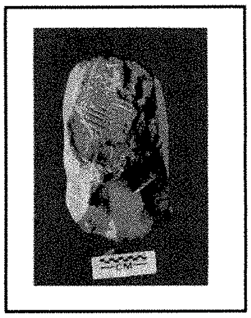

Fig. 9: Engraved chert core, Chandravati

A solitary object found at Chandravati in Rajasthan in the form of an engraved core is highly significant in this context. The design engraved on the semi-rectangular patinated cortex of the chert nodule appears to be a spiral rhomboid (Fig. 9). The design consists of a pair of parallel lines moving clockwise from the centre forming two interwining spiral arms. One of these arms bears a series of short diagonal lines whereas the other has been left plain generating a foreground and background effect. The engraver has taken care to make infinitesimal yet distinguishable marks. This precisely indicates the specific intention of the artist to ensure that the significance and visual effect of the engraved design should not go unnoticed. The design was engraved on the nodule prior to its use as a core (Sonawane 1995-96). Identical designs have been found painted in earlier rock paintings at Mahadev Hills, Cheel Dant, Bhimbetka, Kathotiya and several other places in India, and were identified as examples of pre-figurative rock art. A striking parallel exists even in the Upper Palaeolithic art of Mezin, a site in Ukraine (south Russia) where similar designs have been found engraved on the mammoth ivory female figurines, as well as on an ivory bracelet of the Late Pleistocene period (Clark 1977). The motif engraved on the Chandravati core and its variations found elsewhere in numerous early rock paintings, clearly denote some religious connotations in prehistoric art (Sonawane 1997: 12-14). In this regard evidence obtained from the Upper Palaeolithic site of Baghor 1, Son Valley, Madhya Pradesh (Fig. 10), offers an important convincing clue (Kenoyer *et al.* 1983).

Owing to their close similarity with the design engraved on the Chandravati core, the earliest paintings representing geometric patterns, have unfortunately been attributed to the Mesolithic phase (Sonawane 1992). However the Chandravati specimen is not actually dated, since it forms a part of a surface assemblage. It is merely assumed to be Mesolithic while acknowledging that the engraving on the object predated it's use as a core (Bednarik 1993:34). Tyagi's only objection to Wakankar's observation, is that green paintings representing 'S' shaped dynamic dancing human figures are not the earliest paintings (Tyagi 1992: 310). In the light of new evidence, both from Chandravati and elsewhere, it appears that the design engraved on the Chandravati core may be dated to the Upper Palaeolithic (Sonawane 1997). In the light of this observation, rock paintings representing purely geometric patterns as pre-figurative or non-iconic art forms; and succeeding figurative or iconic depictions painted either in red or green animated human and animal figures, should be assigned to the Upper Palaeolithic period. The existence of such early paintings has been confirmed by other contemporary surviving art objects with a simultaneous development at par with the rest of the world.

Mesolithic Phase

The wide spectrum of rock art of the Mesolithic phase is full of varied descriptive details. It is surprisingly uniform in style and content all over India. There is a remarkable divergence in the degree of abstraction between the depiction of human

Fig. 10: Natural Triangular sand stone found on the Upper Palaeolithic rubble platform at Baghor

and animal forms. While animals are depicted quite naturalistically, human forms are reduced to stick-like figures in a stylistic manner. Sometimes, humans are shown wearing masks or an elaborate head dress. This difference between human and animal depictions is most visible in hunting scenes. Again, in contrast to fragile male figures, the female form is always static with a plump square body. Since animals and women had a bulky form, there was enough room for body decoration. Intricate design patterns like the spiral or honeycomb, are seen in such paintings and thus show continuity with the earlier tradition. There is no clear demarcation between body patterns and 'X-Ray depictions'. Both appear side by side within a single composition. Mesolithic paintings give a remarkably detailed account of various activities, recording minute details of the intended message. The hunting scene which predominates in rock art of this period, shows a variety of game animals, both big and small, being hunted with spears and arrows, tipped and barbed with microliths (Figs. 11-12). They also furnish fairly detailed depictions of a variety of traps used for capturing game, shooting arrows at prey, transporting kill (Fig. 13), butchering, fishing with net traps (Fig. 14), catching rats by pushing a digging stick into the burrow (Fig. 15), as well as the collection of fruits and honey; and other subsistence practices. Apart from these, there are paintings which depict other activities such as dancing, singing, playing musical instruments (Neumayer 1992-93b), drinking and eating inside a roofed house, etc. (Fig. 16). A large number of paintings show subjects which may be classified as religious or cultic. Here, we find mythical stories depicting huge deified animals chasing diminutive human beings. Scenes narrating magical cures or magical treatments signify a deeper meaning. The most touching is the scene of a child burial where family members are mourning (Fig. 17).

Compared to rock paintings, Mesolithic engravings are few and far between, being in the form of mere scratches, figures of animals or abstract patterns. In Orissa (Pradhan 1995) and Bihar (Chakraverty 1996), such engravings were invariably filled with colour. The continuity in the tradition of engravings as a mode of expression, is further supported by the discovery of bone objects recovered from Mesolithic deposits in rock shelter III A-28, of the Bhimbetka complex (Wakankar 1975b). The engraving consists of simple straight or zigzag lines and irregular parallelogrammmatic designs. Apart from this, the evidence of bone and antler rings used as ornamental earrings and components of a necklace from Sarai Nahar Rai and Mahadaha (Uttar Pradesh) supply additional information on the aesthetic taste developed by Mesolithic communities (Pal 1994).

Neolithic and Chalcolithic Phases

An abrupt change is seen in the style and theme between the rock art of hunter-gatherers and that of early agriculturists. The earliest pictures of this period featuring domesticated animals are stylistically well demarcated from those of the preceding periods. The dynamic art of the hunters-gatherers is replaced by progressively stiff and static art forms of agriculturists and cattle keepers. Their thematic spectrum is extremely limited and confined to the depiction of long-horned humped cattle. However when hunting scenes were painted, they give us a good idea about weapons used during this period. Although the most common weapons were bows and arrows, the appearance of metal arrow heads, spears and axes herald a fast changing technology. The complexity of this available technology is best represented by the depiction of chariots. Several large Chalcolithic pictures show processions, accompanied by acrobats, boxers, load carriers and musicians. In several such scenes, chariots and their passengers are prominently depicted showing an advanced stage of social stratification. Agriculture, the economic foundation of this period, is hardly depicted in paintings except those found at Chaturbhujnath Nala and Lakhajoar,

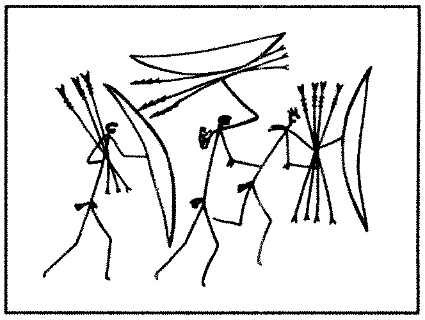

Fig. 11: Hunters carrying arrows set with microliths, Kharwai

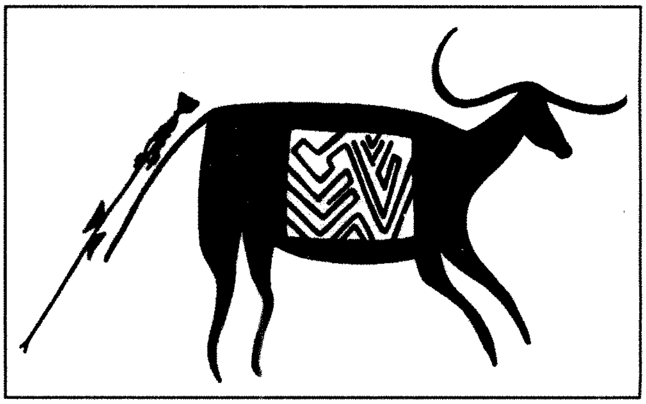

Fig. 12: Transverse microlith set on the shaft, Lakhajoar

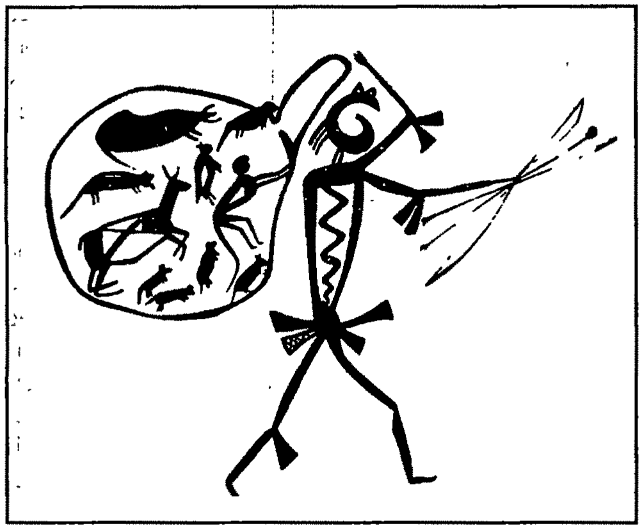

Fig. 13: Transporting the kill, Jaora

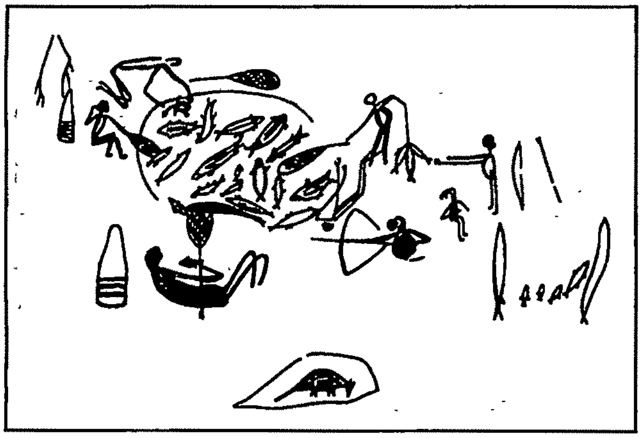

Fig. 14: Fishing scene, Lakhajoar

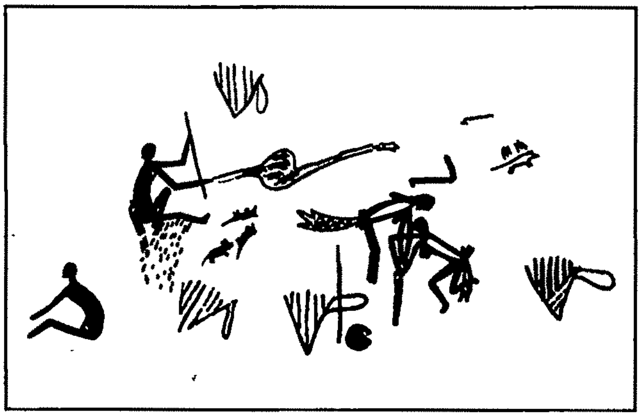

Fig. 15: Women engaged in catching rats, Jaora

where paintings of ploughing farmers are seen. All Chalcolithic pictures of Central India represent a man's world, in which women were depicted peripherally. Similar tendencies are also visible in the Neolithic/Chalcolithic pictures of South India where woman appear very subservient to ithyphallic men. There are also instances of scenes depicting heterosexual intercourse in different postures.

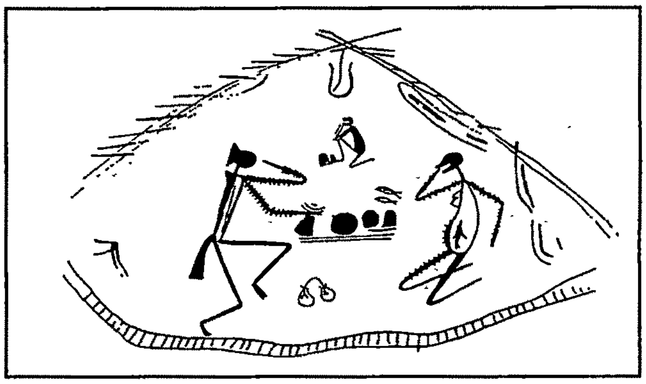

Fig. 16: A family in a hut-like structure, Lakhajoar

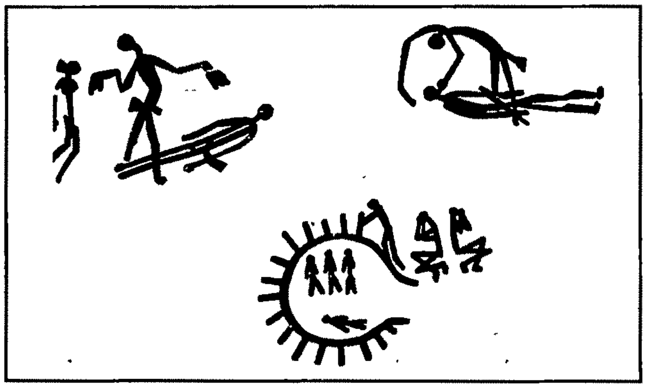

Fig. 17: Paintings depicting magical cures, medical treatment and burial scene, Bhimbetka

Depictions of bullock carts are quite frequent as the common vehicle for transportation. A bruising of a cart from Kupgallu, resembles the terracotta toy cart models reported from several Chalcolithic sites, and is worth recalling (Fig. 18). There are several indications that chariots were drawn by horses, and in paintings too they appear as mounts. Compared to these, elephant riders are sparsely depicted.

Elegant long horned bulls are a special feature of Neolithic/ Chalcolithic pictures in South India, occupying the position of an icon. One interesting depiction comes from Kupgallu where four typical bulls are aligned at the periphery of a circle (Fig. 19). In other pictures, they are placed on a T-shaped pedestal. Besides this, there are several bruisings of large implements. Compared to the size of the accompanying human figures, they are excessively large. These engravings of implements are often placed at prominent points on the granite hills indicating their use as standards or cultic weapons. Likewise, depictions of endless knots recall the design patterns engraved on the copper plates found at Mohenjadaro (Sundara 1996). Of these, several rock art sites are situated in the vicinity of Megalithic burials. Obviously,

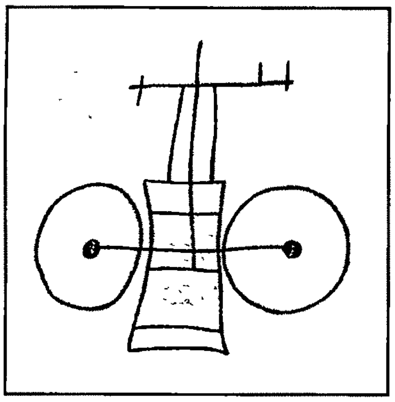

Fig. 18: Rock bruising of a cart, Kupgallu

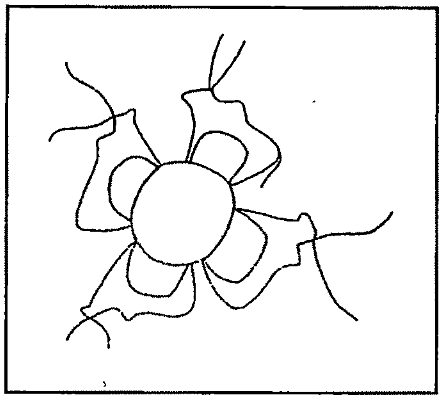

Fig. 19: Rock bruising of long-horned bulls, Kupgallu

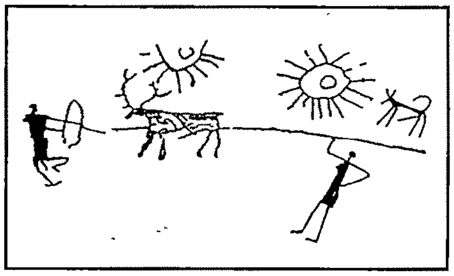

Fig. 20: Hunting scene engraved on a stone-slab, Burzahom

some of the paintings and bruisings can be related to burial practices (Rajan 1991). One such painting shows a dead person within the burial inventory of a stone circle in the Benekal forest.

In the same spirit, rock paintings found in the Karakoram region and Himalayas, particularly in the upper course of the river Indus and its tributaries in Ladakh and Zanskar, show hunters with bows and arrows stalking ibex, deer and bovids (Francfort *et al.* 1992). These compare well with hunting scenes engraved on the stone slab (Fig. 20) recovered from the rectangular structure belonging to the Neolithic phase II at Burzahom, depicting two armed persons hunting a deer (Pande 1971). Another slab found in the same context has an abstract design identified as a tectiform or trap, representing a hut with a thatched domed roof (Pande 1972).

The obvious advantages of dating rock art of this cultural phase is the availability of reliable stratified archaeological data in the form of contemporary protohistoric art forms.

Historic Period

Rock art of the historic period is characterized by the presence of writings in Brahmi, Kharoshti, Shankha and even Nagari scripts, besides the introduction of religious icons and symbols of various prevailing faiths. These include depiction of Krishna, Balarama and Vinadhar Shiva (Fig. 21) at Tikula near Gwalior (Neumayer 1992-93), Ganesha and Yaksha at Bhimbetka, Lajja Gauri at Chintakunta (Andhra Pradesh), Buddha at Satdhara near Sanchi, stupas showing structural and decorative details at Satdhara and Kotra near Narsinghgarh, and Gambhirpura, near Idar (Fig. 22) (Sonawane 2002: 74-76a), Dharmachakra on a pillar, Bodhi tree and a Triratna symbol along with the story of Shravan Kumar at Chibbarnala near Bhanpura. All these suggest the spread of a codified and uniform system of religious beliefs throughout the country. Similar depictions mostly in the form of petroglyphs have been found further north in Ladakh and Chilas (Pakistan) narrating Buddhist themes along with Kharoshti and Brahmi inscriptions (Orofino 1990; Dani 1983: 43-58).

Apart from distinct religious or cultic narrations, rock art of the historic period is dominated by heavily caparisoned horses and elephants often with riders depicting battle scenes, soldiers engaged in fighting equipped with metal weapons such as spears, swords and shields, daggers and occasional bows and arrows. Sometimes soldiers are shown wearing armour. There are also royal processions depicting royal personages standing under canopies. There are pictures representing many aspects of contemporary life of people residing in plains and forests, together with a variety of animals, birds and plants, confined to the regions of rock art distribution. The aesthetic sophistication of some of these paintings, particularly those from Badami (Fig. 23) and Mahadev Hills, is comparable with the famous Fresco paintings of classical Indian art and some show close parallels with Kushana and Gupta sculptural styles in their descriptive details. In this respect, rock painting of sailing boats found at Chamardi (Fig. 24) near Bhavnagar in Gujarat, depicting sea-going vessels current on the west coast of Saurashtra, are unique (Sonawane 1996:72-72). Apart from these, there are several examples of traditionally accepted themes and styles marked by monotonous depictions showing a decline in artistic standards. Geometric and floral patterns, signs, symbols, etc., which are distinctly different from earlier paintings, show strong stylistic and thematic analogies with modern pictures found in houses in tribal belts, and are attributed to a comparatively recent origin; these confirm their popularity and common ethos.

Conclusion

India can be proud of being one of the three countries having the richest treasures of rock art in the world, the other two being Australia and South Africa. The spectrum of Indian rock art is vast, both in thematic and stylistic contents. In magnitude, vividness and richness it is outstanding and in some respects unique in the world, forming an important

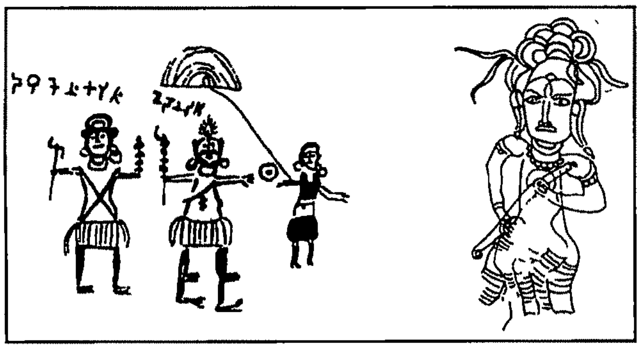

Fig. 21: Balaram, Krishna and Vinadhar Shiva, Tikula

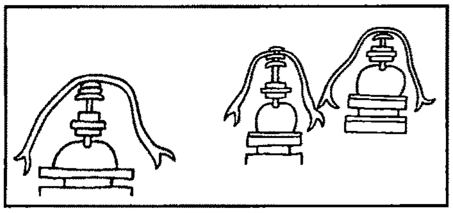

Fig. 22: Stupa paintings, Gambhirpura

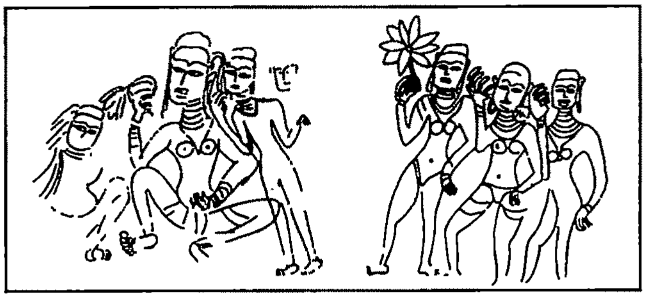

Fig. 23: Classical paintings, Badami

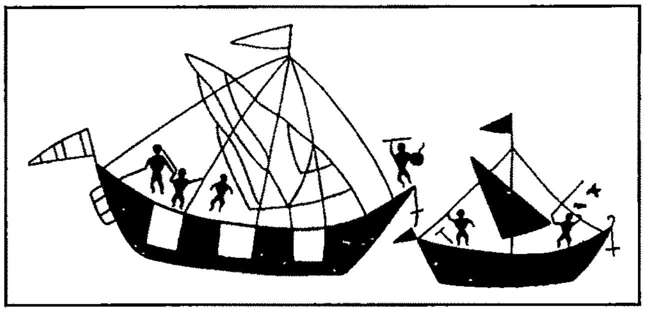

Fig. 24: Sailing boats, Chamardi

cultural heritage of humanity. With its antiquity ranging from the Palaeolithic, down to Historic times, it constitutes visual documents of our ancestors, which are fascinating as well as challenging in terms of their interpretations.

For a long time, the existence of rock art in India was an enigma and its very antiquity was questioned. Though its study was taken up as part of the discipline of archaeology, rather late, it is now regarded as one of the prime sources of information. Extensive painted galleries confined to caverns of rock shelters, boulders and engravings executed on stone, bone and ostrich eggshells, stand as mute testimony to this bygone art (Sonawane 2002: 265b). The rock art of India is distinct and is not comparable with other parts of the world. For example, European rock art was the product of the Upper Palaeolithic period and its subject matter mostly revolves a round the animal world.

Data provided in the preceding pages not only reveals the antiquity and development of rock art in India but also enriches our understanding of the way of life of people of different cultural periods. Though reasons for the occurrence of rock art in various forms is still open to speculation, all these works of art can be regarded as an influence of the mental as well as the physical environments in which they were created. There is some homogeneity in the rock art of different geographical locations, yet the character of each region has its own personality. A cursory glance at the panorama of Indian rock art reveals this fact. Therefore, there is a definite need for regional studies in rock art; and the peculiarities of a micro-region should not be overlooked in a holistic macro-level study. There is no universally standard method for the interpretation of rock art. Subjectivity is always present, leading to speculative identifications and interpretations. The obvious reasons for such shortcomings, are the absence of substantial archaeological, literary and ethnographic data besides oral traditions. Knowing the weaknesses of archaeological data, Kenoyer (1987) has rightly pointed out, that traditionally speaking, objects or patterns of objects with no definite or identifiable utilitarian function are, by default, symbolic in function. Therefore, one has to be very cautious while interpreting any work related to rock art.

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The Lower Palaeolithic: A Review of Recent Findings

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Abstract

The Lower Palaeolithic is the phase of Prehistory which deals with the earliest archaeological evidence. It is quite important to have an overview of the evidence from the entire world to properly interpret the evidence from any particular region. In the last few decades the pace of discoveries has been very rapid and many fundamental changes in knowledge have occurred. Some of the long held ideas have not been supported by recent findings. The "Movius line" does not appear to have any validity in the Indian sub-continent and Southest Asia and only limited validity in East Asia. It continues to hold up in Europe. The diversity of the "earliest" industries in different regions appears quite significant. The Lower Paleolithic of India is unique in the world, in being exclusively Acheulian. Similarity of African and European sequences, with a "mode 1" phase followed by a "mode II" phase, but with completely different chronologies, is puzzling. In this paper an attempt is made to review some of these new findings.

Introduction

The Lower Palaeolithic is not only the earliest period of Prehistory but also the longest period and deals with the time period from the earliest stone tools until the appearance of more advanced tools called "Middle Palaeolithic". Archaeological research has shown that this period is from around 2.5 up to 0.25 million years — truly an immense time span.

The earliest tools are not only much more primitive than any used today but were also used by more primitive forms of man. Man was once defined as the tool maker. Scientific studies of animals however show that not only species closely related to man, like apes, but also unrelated animals like some birds, insects and other mammals also make and use tools. Man is not the tool maker but a tool maker. Archaeological research however begins from the appearance of stone tools and the Lower Palaeolithic deals with the earliest stages of stone tool technology.

Chimpanzee Tool Use

In understanding these earliest stone tools, studies of the most closely related living species, the African apes are quite relevant. It has been found that chimpanzees regularly use tools for obtaining food. Tool use varies between different groups of chimpanzees. One of the most common forms of tool use is the use of small probes made of plant stems or small twigs to extract termites and ants from ant hills for eating. This has been observed in most groups of chimpanzees and is called termite fishing. This tool use is quite interesting as recently, some bones from Swartkraans, where fossils of *Australopithecus robustus* have been found, show use marks indicative of their use as termite fishing tools (Blackwell and D'Errico 2003). A number of chimpanzee groups have also been observed to use stones to break nuts (Boesch and Boesch 1983). Chimpanzees also use chewed leaves as sponges to soak up small amounts of water in tree branches to drink. They prepare nests of leaves in trees every night for sleeping (McGrew 1992; Whiten *et al.* 1999) Very recently a group of chimpanzees has been seen to kill prey with sticks fashioned into spears (Pruetz and Bertolani 2007). The complexity of behaviour of our closest relatives, the African apes, has been brought out by ongoing studies of groups in the wild. This shows us that stone tool making and use was only a marginally more complex behaviour than that documented for living apes. At 2.5 myr, when the earliest tools are found, different species of the genus *Australopithecus*, which were bipedal apes, are found. It is likely that the beginning of tool making pre-dates the appearance of the genus *Homo* and that some or all of the Australopithecine species present at 2.5 myr were stone tool makers/ users.

Archaeological Terminology

Archaeological terminology in use has been developed over the last 150 years. The pace of discoveries, many of them completely unanticipated, has rendered many of the traditional archaeological terms obsolete and, at times, misleading. The terms in use will first be explained and then their appropriateness in view of recent archaeological findings will be discussed.

The term Lower Palaeolithic is an elaboration of the Three Age system. In Europe, in the nineteenth century, when the discipline of Prehistory was being developed, the first breakthrough was the realization that there had been

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an evolution of technology. Thus the past was divided into three successive periods — an age of Iron, Bronze and Stone. Manufacture of tools out of stone was due to the absence of metal technology and the use of bronze for tools was due to the lack of a technology to smelt iron. The Stone Age was further divided into the Old Stone Age or Palaeolithic and the New Stone Age or Neolithic. Later, another stage of Mesolithic was inserted in between the Palaeolithic and Neolithic and the Palaeolithic further divided into Lower, Middle and Upper Palaeolithic. The subdivisions of the Palaeolithic were mostly based on artefacts collected from the river terraces of France and England and the excavations of French caves. In Africa, the absence of a technological phase equivalent to the Upper Palaeolithic led to the use of the terms, Earlier, Middle and Later Stone Age, equivalent to the Lower and Middle Palaeolithic and the Mesolithic. Both these terminological systems are based on the assumption of an evolution of technology. Foote (1916) divided Indian Prehistory into Palaeolithic and Neolithic phases. Cammiade and Burkitt (1930) divided it into Series I-IV, more or less equivalent to the European Lower, Middle and Upper Palaeolithic and Mesolithic. In the early 1960's and 1970's, Indian Prehistorians used the African terminology but later changed to the European one which is now in use.

A second type of terminology used was the naming of a technology after a type site where it was first identified. Terms such as Acheulian, Abbevillian, Clactonian and Oldowan are based on the type site concept. Here naming an assemblage after a type a site only implies it has a similar technology and typology to the named type site and does not imply any evolutionary sequence. Acheulian and Abbevillian are named after sites in France, Clactonian from a site in England and Oldowan from Olduvai Gorge in Tanzania. Terminologies based on the three age system and type sites are both in use.

The reason for the use of both the terminologies is the fact that during the period of the Lower Palaeolithic, there are two main types of stone tool industries, those with hand axes, called Acheulian and those without handaxes. The presence of handaxes was used to identify a stone tool assemblage as Acheulian. This is the type fossil approach and is borrowed from paleontology, where the presence of a particular type of fossil was indicative of a particular geological horizon. Handaxes are hand sized pieces of stone that have been shaped by the removal of flakes from both sides of the tool. Pointed forms are called handaxes and non pointed forms are called cleavers. The concept of Acheulian, defined by the presence of a type of artefact called a handaxe has dominated classification of Lower Palaeolithic stone tool assemblages. In Europe, the Clactonian is a stone tool industry contemporary to the Acheulian, lacking handaxes. Handaxes were considered to be absent from Central Europe, East and Southeast Asia during the Lower Palaeolithic. On this basis Movius (1944, 1948) suggested that there were two technologies during the Lower Pleistocene, one with and one without handaxes, with different geographical distributions. This led to the concept of the Movius line, with handaxes found to the west of the Movius line, in Peninsular India, Africa, the Middle East and Western Europe and non handaxe, chopper chopping tool industries to the east of the Movius line in Central Europe, East and Southeast Asia. This concept is still considered to have some validity by some scholars, although it has been rejected by many.

Because the Lower Palaeolithic did not encompass a homogenous technology and there appeared to be the co-existence of the more advanced Acheulian technology with the less advanced non-handaxe technology, Grahame Clark (1968) in his synthesis of world prehistory, suggested yet another terminology. Clark divided the Palaeolithic into technological modes, with the technology as the defining factor. Lower Palaeolithic industries without handaxes were called mode 1 while those with handaxes are mode 2.3 was industries with prepared mode core technology, mode 4 blade technology and mode 5 microlithic technology. In recent years this terminology has become fairly popular. To a large extent it does not differ greatly from the Three Age System, except that it explicitly allows for the co-existence of different technological modes at any one time period.

In the last few decades there has been an explosion of work in many parts of the world (Mishra 2006-2007), with an input of new dating technologies and new methods of studying fossils associated with the stone tools. Many unexpected discoveries have been made which have forced a revision of deeply held assumptions. The work on ancient human and animal fossils has begun to contribute a large amount to interpretations of the past. Use of *any* of the above discussed terminologies has been reduced and a synthesis of the newly acquired knowledge is awaited. Differences in the early archaeology of different geographic regions of the world now appear to be more substantial than they did earlier, when it was expected that the European sequence would be replicated in other areas studied. Europe, still the best studied region, is now widely accepted to be at the periphery of major events in human evolution with the continent of Africa as the central one. It is still unclear how the records of stone tools, human fossils and genetics of living humans relate to each other as somewhat contradictory conclusions follow from the different data sets.

Africa

There are two Lower Palaeolithic or Early Stone Age industries in Africa, the Oldowan and the Acheulian. Most of the assemblages referred to as Early Stone Age belong to the Acheulian. The Oldowan dates from 2.5 myr to around 1 myr. Although there is some variation in the industries labeled Oldowan, there appears to be little increase in complexity of the industries through time as the earliest assemblages at Gona in Ethiopia (Semaw 2000; Semaw *et al.* 2003) closely resemble the youngest ones at sites like Olduvai Gorge (Leakey 1971); Konso Gardula (Asfaw *et al.* 1992) Peninj (Domínguez-Rodrigo *et al.* 2002) and Melka Kunture (Chavaillon *et al.* 1979, Chavaillon and Piperno 2004). At around 1.4 myr a distinctively different stone tool technology called "Early Acheulian" is found at a number of sites in East Africa. This industry does evolve through time with some new technological features appearing before the end of the lower Pleistocene. It has been divided into Early and Late Acheulian. The transition from Acheulian to Middle Palaeolithic is gradual (McBrearty and Tryon 2005).

Oldowan

The Oldowan stone tools were first defined on the basis of excavated sites from Olduvai Gorge, Tanzania, where they date between 1 to 2 myr. Other localities in East Africa, like Koobi Fora (Isaac 1997) and West Turkana in Kenya (Roche *et al.* 1999), Peninj in Tanzania (Domínguez-Rodrigo *et al.* 2002), Konso Gardula (Asfaw *et al.* 1992), (Beyene *et al.* 1996), Melka Kunture (Chavaillon and Piperno 2004) and Fejej (de Lumley and Beyene 2004) in Ethiopia, also have a series of excavated sites contemporary to Olduvai Gorge. Oldowan has also been reported from the site of Sterkfontien in South Africa (Kuman 1998) and at Ain Hanech in Algeria (Sahnouni *et al.* 2002) where they date to around 1.8 myr. Sites around Casa Blanca on the Altantic coast of Africa have not been confirmed to have a separate Oldowan horizon (Raynal *et al.* 2002). A number of localities in East Africa, such as Gona in the Hadar region of Ethiopia, the Shungara Fm, in the Omo region of Ethiopia (Merrick and Merrick 1976), the Lokalalei sites in the West Lake Turkana sequence in Kenya (Roche *et al.* 1999) and at Kanjera West (Bishop *et al.* 2006) in Tanzania have been dated between 2.0 and 2.5 myr. Currently the oldest site is Gona from Ethiopia. Two events occur during the time range of the Oldowan in Africa. The first is the appearance of *Homo* and the second is the appearance of the Early Acheulian.

At 1.8 myr the genus *Homo* is found, both in Africa as well as Asia. Its dispersal is remarkably widespread. At Dmanisi, in Georgia four individuals have been found in sediments dating to 1.8 myr (de Lumley *et al.* 2002; Gabunia *et al.* 2000). It has been designated as *Homo georgicus* and has a significantly smaller body size compared to *Homo erectus* in Java. At Mojokerto in Java (Swisher *et al.* 1994), *Homo erectus* has been dated to 1.8 myr. In Africa the situation is the most complex with *Homo erectus/ergatser* and *Homo habilis* present. Spoor *et al.* (2007) have recently shown that these two species of *Homo* co-existed for around half a million years in East Africa, making it unlikely that *Homo hablis* was the ancestor of *Homo erectus/ergatser. Homo erectus/ergatser* is also much more sexually dimorphic than thought earlier (Spoor *et al.* 2007). The earliest Acheulian appears later than *Homo erectus* at 1.4 myr and the early *Homo* outside of Africa at Dmanisi and Mojokerto are not associated with Acheulian but with industries more similar to the Oldowan. There is some dispute about whether there is any technological evolution of the Oldowan industries. While some scholars think that there may be a few new features in the late Oldowan, scholars studying the earliest industries, such as Gona, West Kanjera, Lokalalei 2 have stressed the presence of advanced features right from the beginning.

The surprising thing about the Oldowan stone tool industry is its sophistication. There is a clear selection of stones for flaking, with stone types having superior flaking qualities being selected. There is also a good understanding of the principles of flaking stone, so that a larger number of flakes can be removed from it. At Lokalalei 2 more than 80 flakes were removed from a single core (Roche *et al.* 1999). Raw material for making tools is obtained from a radius of at least 5 km. Transport of stone into the site and out of the site is also seen. The cores in the Oldowan are mostly cobble sized, which means they are of a size to be easily held in the hand as tools and can also easily be carried. Initially they were characterized as tools, in Mary Leakey's typology (Leakey 1971), but later Toth (Toth 1985) considered them to be primarily cores. Isaac (1997) used a terminology of flaked pieces (cores/choppers), detached pieces (flakes) and battered pieces, avoiding assumptions as to whether the cores or flakes were the tools. The small flakes detached from these stones were most probably used as tools. Use wear analysis of some flakes from a site at Koobi Flora shows them to be used in contact with both plant and animal material (Toth 1985). Residue from *Acacia* wood has been identified from a biface from the site of Peninj (Domínguez- Rodrigo *et al.* 2001). A large amount of flaking debitage is found at all the Oldowan sites with up to 80% of the assemblage consisting of flake fragments. Leakey (1971) has identified secondary retouch on many pieces, but recent restudy by de Torre and Mora (2006) has considered most of the retouch to be unintentional damage. There is also a significant battered component of stones used as hammer stones. Different stone types were often preferred for making different tools with harder stone like quartz preferentially used for hammer stones. At Peninj, recent work has suggested that the core reduction does show some planning (de la Torre *et al.* 2003). De Torre and Mora (2006) have on the other hand pointed out very significant differences between the Oldowan and Acheulian at Olduvai Gorge, with the Acheulian distinguished, not just by the presence of bifaces, but also with more complex core reduction strategies and increased transport of stone over the landscape. A more primitive technology is only so far documented for one of the Lokalalei localities. Here the earlier site Lokalalei 1 has yielded an assemblage in which cores are not fully reduced and flaking appears clumsy (Kibunjia 1994), while at the later site of Lokalalei 2 A, very good flaking technique is found with refitting of one core showing detachment of more than 80 flakes (Roche *et al.* 1999). The two sites were initially considered almost contemporary, but recent geological work at the locality has shown that the assemblages may differ in age by as much as 200,000 years (Brown and Gathogo 2002). At Omo also it had been suggested that some of the assemblages were more primitive than the Oldowan (Merrick and Merrick 1976), but recently de Torre (de Torre 2004) has re-studied the material and found that much of the collection was not artefacts at all and when the non artefacts were removed from the assemblage, it no longer appears so primitive.

Acheulian

In East Africa, Acheulian sites date to 1.4 myr from Olduvai Gorge, Koobi Fora, Peninj, Konso, Melka Kunture West Lake Turkana and Fejej. Some of the earliest assemblages have quite well made handaxes, leading archaeologists like (Leakey 1967) and (Kleindienst 1961) to assert that there was little evolutionary change. In some cases elaborate developmental schemes for the Acheulian have been made, but none of these has held up when well dated and complete assemblages have been compared. The assemblages from Olduvai Gorge and Koobi Fora are presently the best studied and published, although important work is going on at Peninj, Konso, Fejej and Lake Turkana. The biggest contrast between the Acheulian and the Oldowan is an increase in the size of the tools and the detachment of large flakes from giant cores. The handaxes in the Early Acheulian are mostly trihedral or pick shaped. Very few flakes are detached to shape the tool and these are primarily to obtain the pointed tip. The tip is often trihedral in cross section. Along with the handaxes and cleavers hand sized flakes are found. Small tools are fewer in number but small cores to detach small flakes are found. This shows that the small flakes characteristic of the Oldowan are also present in the Acheulian. The component of battered tools which are found in abundance in the Oldowan are present but in fewer numbers in the Acheulian. The large flakes, which mostly fall in the size of 12-16 cms were detached from cores which could be 20-50 cm in diameter. The cores for obtaining the large flakes are often not present at the sites. Some have been reported from some of the sites in Ethiopia (Schick and Clark 2003). At both Koobi Fora and Olduvai Gorge, the Acheulian sites are less frequent than the Oldowan sites and this is probably true for the other localities mentioned above. The excavators feel that the Acheulian sites are more disturbed by geological processes than the Oldowan ones as there is less small flake debitage preserved, but this also could reflect the separation of different parts of the tool manufacture in different parts of the landscape.

The Acheulian is found widely in Africa. In South Africa, at Sterkfontien, Acheulian is found in sediments dating to around 1.4 myr, similar in age to the appearance of Acheulian in East Africa (Kuman 1998). Artefacts in the Vaal River gravels, recovered in the 19th and early 20th century during mining for diamonds, were the early focus of study of the Acheulian (Goodwin 1926; Van Riet Lowe 1952). It was recognized by them that the Acheulian in Africa differed significantly from that in Europe and that a number of prepared core technologies, like Kombewa and Victoria West techniques were used in the Acheulian to obtain the large flakes. The Victoria West technique is the use of radially prepared cores to remove large flakes for handaxes. It is undated in South Africa where it was first reported, but (McBrearty and Tryon 2005) have dated its occurrence to between 285-500 kyr in East African Kathurin formation. Beaumont and McNabb's recent excavation at Canteen Koppie near Kimberly on the Vaal river found that the deposit was not fluvial, but a colluvial one (Beaumont and McNabb 2002). The lowest layers showed no prepared cores, followed by the presence of Levallois like cores and then Levallois and Victoria West cores. The rubble is overlain by aeolian sand containing a terminal Acheulian industry (Fauresmith). A number of caves in South Africa also gave long Palaeolithic sequences. At Wonderwerk cave, (Beaumont and Vogel 2006) slow sediment accumulation has led to a long sequence with Acheulian during the Matuyama period. Recently (McNabb, Binyon and Hazelwood 2004) have done an intensive study of bifaces from a number of South African sites, espeacially Cave of Hearths. They find that while the tip of the tools show some standardized shapes the body form of the tools was not well standardized or very symmetrical. Most of the secondary flaking was confined to the margins of the tools and was often only partial so that it does not appear that the tool makers were trying to impose any pre-determined shape on the tools.

In Northern Africa, along the Mediterranean and Atlantic coasts, Lower Palaeolithic artefacts have been found for the last 100 years in relation to an emerging coast which has placed the older sites at higher elevations and tens of kilometres inland. These sequences were studied in detail by Biberson (1963, 1967) and others and a fairly elaborate developmental sequence for the Acheulian was postulated. Presently, new excavations and application of modern dating techniques are being applied to some of these sites. The oldest site is Ain Hanech, for which an age of around 1.8 myr, based on correlation to the Olduvai event has been estimated. At Casa Blanca, on the Atlantic coast, Raynal *et al.* (2004), suggest that no separate horizon for Oldowan is present and that the oldest site is Thomas's quarry level L, estimated to date to around 1 myr (Rhodes *et al.* 2006). The Acheulian sequence at Casa Blanca is known from recent excavations at the localities of Sidi Abderrahmane and Thomas Quarry localities.

The Acheulian sequence shows an increase in complexity of reduction sequences through time. A variation in the amount of bifacial elements in the assemblages is also seen with a few assemblages in the Middle Pleistocene lacking handaxes, although still considered part of the Acheulian variability The Acheulian cleavers and handaxes are made on large flakes here as elsewhere in Africa and various prepared core techniques to produce flakes for cleavers such as the Tachengit and Tabelbala techniques have been identified.

The evolution of Acheulian into the Middle Stone-Age in Africa appears to be gradual. The dating of the last occurrences of handaxes is still difficult. The date of around 270 kyr has been suggested for South Africa (Beaumont and Vogel 2006) and also for the Kapthurin formation in Kenya (McBrearty 2003). However the Herto site in Ethiopia, recently published as the earliest site with archaic *Homo sapiens*, dating to 160 kyr also has handaxes (Clark *et al.* 2003; White *et al.* 2003). These are some of the youngest handaxes dated so far.

Summary

The Lower Palaeolithic in Africa includes the earliest stone tool assemblages, attributed to the Oldowan, which has a time range of 2.5-1.0 myr. It is characterized by the production of small sharp flakes from cobble sized cores. Cobble sized pebbles and nodules were also used as tools both as choppers with working edges produced by flaking and as hammer stones. Oldowan sites are associated with a lot of debitage, showing production and discard of tools at the same locality. The Early Acheulian appears in the African record at around 1.4/1.6 myr and continues until around 250 kyr except at Herto where handaxes are dated as young as 160 kyr (Clark *et al.* 2003). The Early Acheulian shows a shift to the use of large flakes detached from giant cores. Hand sized tools with sharp edges, hand sized tools with pointed edges and small flakes and hammer stones are the main tools. In the Early Acheulian deliberate shaping of the stone to produce a pre-determined shape although widely assumed by comparison to the later European Acheulian, may not actually exist. Nevertheless, the production of large flakes from giant cores shows that curation of the flakes was obligatory as the giant cores they were detached from cannot be carried around. Most probably, therefore the Acheulian may be an indicator of more complex behaviour compared to the Oldowan, although there is little difference in the complexity of the technology. The Acheulian probably evolves in complexity through time, although the exact stages are not well established and some workers suggest no evolution. The most common explanation for the co-existence of Acheulian with Oldowan through the time period of 1.4 myr to 1 myr is differences due to different activities in different parts of the landscape.

Europe

The First One Million Years: A pre-Acheulian horizon, prior to 500 kyr

Europe is still the best studied region of the Palaeolithic world. Roebroeks and Kolfschoten (1994) suggested that all the evidence for human presence in Europe prior to half a million years was dubious and essentially Europe was not occupied until around half a million years. This is the short chronology. Almost immediately however, the excavation of the limestone fissure at Atapuerca in Spain, showed not only artefacts but also human fossils in levels below the Bruhnes Matuyama boundary (800 kyr) in the TD6 and TD 4 levels (Carbonell *et al.* 1995, 1999). The consensus now is that while the short chronology remains valid for temperate Europe, it is not valid for Mediterranean Europe (Roebroeks 2006). In Spain and Italy, a number of well dated sites with large numbers of artefacts have been dated to more than 1 million years. No Acheulian is present at these sites. The earliest Acheulian in Europe, is much later than the earliest Acheulian in Africa, appearing first in Mediterranean Europe and then in parts of temperate Europe. In temperate Europe, Acheulian industries are only present in Britain and France and other non biface industries are present in other areas.

The three well excavated and studied early sites in Italy are Monte Poggiolo (Peretto *et al.* 1998; Peretto and Ferrari 1995), Isernia (Peretto 2006) and Notarchirico in the Venosa basin (Piperno 1999). The date of Monte Poggiolo has been estimated by palaeomagnetism and ESR to date between 800 kyr to 1 myr. Thousands of stone tools have been found and an unusually large number of refits (17% of the assemblage) could be made. Simple detachment of flakes from pebbles is documented and there is virtually no secondary flaking in the assemblage (Santonja and Villa 2006; Villa 2001). The site of Isernia has yielded four large excavated artefact assemblages (Villa 2001). The stone industry consists of simple cores and flakes. Refitting of the artefacts shows that the flaking activity was insitu. Use wear analysis of the flint flakes from the site shows them to have been used so that they formed the main tools of the site. Dating of the archaeological layers by dating of volcanic ash layers indicates an age close to the Bruhnes Matuyama boundary (700, 000) and palaeomagnetic studies implied a reversed magnetic field. However microfauna from the site and new palaeomagnetic studies imply the site may be younger, in the Early Bruhnes chron. At Notachirico and the adjoining site of Loreto, over 20 archaeological levels have been excavated (Santonja and Villa 2006). Volcanic ash interlayering with the sediments dates the sites to the beginning of the Bruhnes period (650-450 kyr). The first Acheulian assemblages occur within the Notachirico sequence. Acheulian is interstratified with non Acheulian with the youngest assemblage is non-Acheulian. Recently 3 cores and 6 flakes have been reported from a new site in Southern Italy, at Pirro Nord (Arzarello *et al.* 2006), a site already well known for its faunal assemblages. The associated fauna implies an early Pleistocene date, perhaps between 1.6 to 1.3, making it significantly older than the sites of Isernia, Monte Poggiolo and Notarchirico and bridging the gap between them and Dmanisi.

In Spain, the Fuente Neuve 3 and the Barranco Leon 5 assemblages, from the Orce basin (Gibert *et al.* 1998; Oms *et al.* 2000) belong to the Matuyama epoch. The ongoing excavations of the Atapuerca locality have given incontrovertible evidence for man dating to the Matuyama epoch (Carbonell *et al.* 1999a).

The most recent discovery has been the finding of a flake assemblage in the Cromer Forest Beds of Britain, after more than a century of searching. At Pakefield new exposures uncovered a small lithic assemblage, in good context (Parfitt *et al.* 2005). The Pakefield occurrence is dated by biostratigraphy to the early part of the Bruhnes chron with the rodent fauna more ancient than the Italian site of Isernia. This shows widely dispersed human populations at the beginning of the Bruhnes period. The palaeoenvironmental data from Pakefield however showed that climate during the period of human occupation was basically Mediterranean with rainy winters, with no frost.

The most spectacular and unexpected evidence to be obtained in the last decade is the amazing site of Dmanisi which is well dated to 1.8 myr. Dmanisi is in Georgia, at the gateway to Europe (Gabunia and Vekua 1995; Gabunia *et al.* 2000, Lordkipanidze *et al.* 2005, Vekua *et al.* 2002). At this site 4 skulls and mandibles and some postcranial bones have been found. Although initially attributed to *H. ergatser*, they have now been designated as *Homo georgicus*. Recently a very comprehensive study of the stone tool assemblage from the Dmanisi site has been published (de Lumley *et al.* 2005). De Lumley *et al.* (2005) call the industry Pre-Oldowan. The tools are made on pebbles brought from the river gravels and introduced into the site. 33.8% of the assemblage is whole pebbles many of which show percussion marks indicating their use as hammer stones or anvils. Slightly smaller percentage (30.4%) of the assemblage consists of broken pebbles and pebble fragments. The most common tool is pebble tools with a cutting edge formed by the removal of a few flakes. Unmodified flakes are also very common and were also used as tools. Some of the pebbles were cores with most cores knapped only from a single face, with rarer examples of exploitation from multiple faces. The technology of this industry is compared to that of the oldest industries in Africa which they, in contrast to most of the other workers designate as Pre-Oldowan rather than Oldowan. The technology of the Dmanisi lithics is quite comparable to that of the early, Pre-Acheulian horizon, identified from Mediterranean Europe

This early evidence of man in Europe is difficult to interpret. It is also interesting that the African sequence of core and flake industries followed by biface industries is repeated in Europe, but with a different time scale. Thus Turner, (1992) suggested that Acheulian technology only appeared after the extinction of sabre toothed cats, which was earlier in Africa compared to Europe. He suggested that *hominins* could not compete with these ferocious carnivores. On the other hand, Arribas and Palmqvist (1999), Martínez-Navarro and Palmqvist (1995) and Palmqvist *et al.* (2003) suggest that the saber toothed cats could not efficiently strip the animal carcasses of meat, opening up a scavenging niche, which *hominins* occupied. Understanding the interactions of *hominins* with other carnivores for food in the Lower and Middle Pleistocene has become a major research focus as ultimately the colonization of the more temperate parts of Europe required a shift to greater carnivory.

Population densities appear very low with few sites in the Matuyama period. The density of lithic material also appears lower than for comparable sites in Africa (Villa 2001). The analysis of the Dmanisi material shows that a large amount of the stone in the site is directly used for pounding rather than making stone tools. Perhaps tools made on material other than stone had greater importance in Europe compared to Africa. While the number of well documented sites suggests a very low population density, the surprisingly early date for Dmanisi and the presence of sites on the outer most edges of the Mediterranean ecozone at Pakefield, suggest on the contrary, a well established and stable population, for which extremely low population densities are unlikely.

Europe: The Last Half a Million Years

Evidence for man in the temperate parts of Europe, to the north of the Pyrenees-Alp mountain chain becomes convincing after around 500 kyr. Stone tool technologies in Europe, throughout the Lower Palaeolithic consist of Acheulian, found in Southern and NW Europe and non Acheulian, recently labelled as the LPMT (Lower Palaeolithic microlithic tradition), found in Eastern and Central Europe and Asia and possibly related to the Lower Palaeolithic in China (Burdukiewicz and Ronen 2003)

River terraces in Europe form sequences of staircases, with older terraces at higher levels. This has been explained by continuous slow uplift in most regions. The terrace sequences from France and Britain were important in establishing a relative chronology for the Palaeolithic in the 19th and 20th Centuries. The availability of absolute dating and a shift by archaeologists to the study of non fluvial contexts such as caves, led to a temporary eclipse in the importance of the terraces sequences. In addition, marine and ice cores showed that there were around seven ice ages in the last 700,000 years, instead of four in the last

2 million years as thought earlier. Restudy of the terrace sequences however has allowed them to be correlated to the Oxygen isotope stages of the marine and ice cores This in turn, allows sites from different terrace systems to be correlated to each other. Bridgland *et al.* (2006) have correlated the terrace systems of many of the European rivers to the standard oxygen isotope stages (OIS) and suggests that Acheulian tools first occur in terraces belonging to OIS 13 in Britain and France while in Spain and Italy perhaps they occur by OIS 15. One of the best recently studied Acheulian sites in Europe is Boxgrove in Britain. Very well made, small ovate handaxes occur. Although the handaxes are superbly made, the associated fauna indicates it is one of the oldest Acheulian sites in Europe and is considered to date to OIS 13. British archaeologists have found that the revised terrace sequence shows that the Clactonian, a non Acheulian Lower Palaeolithic industry, occurs at the beginning of two separate interglacials — OIS 11 and 9 and in each case was replaced later in the interglacial by Acheulian. It is also interesting that handaxes of particular types such as twisted ovates and boute coupé occur in deposits of different ages, suggesting that the shapes of handaxes have a chronological significance (White 1998a, 1998b). They have also suggested that the appearance of Levallois technique occurred in OIS 9 at around 350 kyr and should be considered the marker for the Lower to Middle Palaeolithic transition.

Some of the best Lower Palaeolithic sites in Europe come from Germany where the presence of limestone bedrock in the Wipper (Bilzingsleben) (Mania 1995, Mania and Mania 2003), Ilm (Ehringsdorf) and Necker (Mauer and Steinheim) – rivers has led to the formation of travertines, in which there is good preservation of non stone as well stone archaeological material. The Mauer mandible is one of the oldest hominin remains from Europe and has been placed in OIS 13. The stone tools from these sites have been placed in the LPMT discussed above. Although the stone tools appear crude, preservation of casts of wooden spears at Schöningen show the presence of hunting weapons (Thieme 1997). These are the earliest wooden artefacts anywhere and compare from a wooden spear earlier found associated with the Clactonian site in Britain (Wymer 1985). The Lower Palaeolithic Microlithic Tradition (LPMT) has a wide distribution in Central, Eastern and Northern Europe. Although the stone tools appear crude, this may be primarily due to the lack of large stone material in the landscape. Tools made from wood and bone may have supplemented the toolkit as indicated by the Schöningen discovery. This lower Palaeolithic tradition may originate from the earlier non-handaxe industries of Europe or be related to similar industries in China.

Summary

European Lower Palaeolithic has a greater than warranted importance due to the discipline of Prehistory originating from Europe. Probably the best studied sites are still from Europe. A division along ecological lines into Mediterranean Europe and Temperate Europe is probably significant with Mediterranean Europe occupied by around 1 myr and Temperate Europe only by around 500 kyr. Even after 500 kyr Temperate Europe was abandoned during glacial phases with refuge populations in Mediterranean Europe re-colonizing the temperate zone in each interglacial. Acheulian sites are only found in Mediterranean Europe and Western Europe (France and Britain), with large areas of European Lower Palaeolithic having stone tool industries belonging to the LPMT. Adaptation to the temperate climate of Northern Europe continued with the ultimate ability to survive at the borders of the northern ice sheets achieved during the last Ice Age (OIS 4). One of the best known forms of fossil man, the Neanderthals are the result of populations evolving within the Eurasian subcontinent. Their ultimate replacement by modern man dispersing from Africa is widely accepted.

Middle East

The Middle East is one of the areas that was continuously occupied from an early period. It is a crucial area as it connects Africa, considered the place where man originated to both Europe and Asia. There are two alternative routes of dispersal from Africa through the Middle East, one through the Nile valley and then the Levant on the Mediterranean coast and the second from the Horn of Africa across the narrow entrance of the Red Sea via Arabia. The first route is considered the most important one, but increasingly the second one is being seriously considered.

The earliest well documented site in the Middle East is Ubeidiya, from Isreal, which was excavated extensively (Bar-Yosef and Goren-Inbar 1993). The artefacts at Ubeidiya occur in lake margin deposits which have been tilted. Palaeomagnetism and fauna from the site are indicative of an age similar to that of the Acheulian at Olduvai Gorge and it is generally accepted to date to around 1.4 myr. Artefacts have been found throughout the sequence. It demonstrates that the earliest occurrence of Early Acheulian outside of Africa is of a similar age to that in Africa. It has been considered that Ubeidiya, represents a limited dispersal of Early Acheulian from Africa (Bar-Yosef and Belfer-Cohen 2001, Goren-Inbar and Saragusti 1996). However, recently documented presence of Early Acheulian of a similar age in India shows that the distribution of Early Acheulian is not confined only upto the Middle East but extended upto peninsular India. After a long time gap, a second important Acheulian site is that of Gesher Benot Ya'aqov (GBY) also in tilted sediments in the Jordan Rift valley. GBY has been dated by palaeomagnetism to the Bruhnes Matuyama boundary dated to ~780 kyr. The stone industry at GBY is dominated by cleavers. Giant cores for the cleaver flakes have also been found. There is a high variability in the tool contents from different layers with one pavement of bifaces exposed in which over 50 bifaces were found (Goren Inbar and Saragusti 1996). The site of GBY also has excellent preservation of organic remains (Goren Inbar, Werker and Febeil 2002) and it has been suggested that nuts were being exploited by the hominids at the sites (Goren-Inbar *et al.* 2002). Perhaps one of the most important findings from the site was the study of burnt flint microdebitage which indicated the use of fire by humans at the site (Goren-Inbar *et al.* 2004). In the later part of the Lower Palaeolithic, Late Acheulian sites are commonly found, both in caves and on the surface (Bar-Yosef 1994).

Dispersal from Africa via the Horn of Africa directly via the Arabian Peninsula has recently been considered (Derricourt 2005). The Bab el Mandab straits, at the entrance of the Red Sea, which separate the Horn of Africa from the Arabian Sea, are only 20 km wide at present. During periods of low sea levels the distance is reduced to 5 km (Flemming *et al.* 2003). The opening of the Red Sea itself is an ongoing process. It is quite possible that geographic connections between the Horn of Africa and Arabia were even more favourable in the past. Considering that the best evidence for early Australopithecines, going back to almost 6 myr, come from the Afar area, immediately adjacent to this crossing point so that an early dispersal out of Africa via this route is a distinct possibility. Considering the harsh environmental conditions on the Arabian Peninsula today, comparatively little work has been done there. Nevertheless a large number of Early Acheulian and even Oldowan sites have been discovered in the Arabian Peninsula, which were recently reviewed by Petraglia (2003).

South Asia

Evidence for the Lower Palaeolithic in India is abundant. The earliest artefacts are from Riwat, in Pakistan where a core and a few flakes were found in a gravel which was initially dated palaeomagnetically to 2 myr years (Dennell, Rendell and Hailwood 1988a, 1988b) but later to 2.5 myr years (Dennell 1998), close to the age of the earliest stone tools in Africa . However, later sediments dating between 2.2-1.2 myr, examined in the Pabbi hills area, also in Pakistan, yielded an amorphous surface assemblage with no *insitu* artefacts (Dennell *et al.* 2004), leading Dennell (2003), to suggest a lack of continuity in the record.

It was initially thought that the Acheulian was absent from Northwestern India, putting it on the chopper chopping tool side of the Movius line. In the 1980's Acheulian artefacts were found in Pakistan, India and Nepal from areas where Siwalik sediments were exposed (Corvinus 1990, Kumar and Rishi 1986, Mohapatra 1981, Mohapatra 1990, Rendell and Dennell 1985). The Soanian sites occurred where the post Siwalik dun sediments or river terrace gravels were exposed (Mohapatra 1990). The Soanian therefore is younger than the Acheulian and is mostly Late Pleistocene in age and so should not be considered Lower Palaeolithic at all (Gaillard and Mishra 2001). Recent typological studies of artefacts curated at Cambridge University from the original de Terra and Patterson explorations also suggest that the Soanian has characters of the Middle Palaeolithic (Lycett 2007). Acheulian found in NW India, has been considered Late Acheulian with intensively retouched handaxes and cleavers (Chauhan 2003). Corvinus (Corvinus 2006) however based on her study of the Satpati handaxes has suggested that this is not the case; an opinion shared by Gaillard (personal communication) based on her study of the Aitbarpur bifaces. It appears probably that actually the Acheulian artefacts are highly curated artefacts being discarded as single tools in an area where large stone pieces are rare, a suggestion made by Mohapatra (Mohapatra 1997) Dennell (2007) has speculated on the impact of the raw material constraints on the occupation of the area. Although Acheulian artefacts have been found at a large number of localities, the context of the Acheulian is still unclear. This however is most probably due to their actual occurrence as single artefacts.

In Peninsular India, Palaeolithic assemblages lacking handaxes are rare. Four sites, Durkhadi (Armand 1983), Mahadeo Piparia (Khatri 1962) and Samnapur on the Narmada river (Misra *et al.* 1990a, 1990b) and Lahchura (Pant 1982) on the Betwa river are assemblages without handaxes. Although Khatri did claim that the Mahadevian was equivalent to the Oldowan, it is generally considered that these assemblages post date the Acheulian rather than pre-date them. Considering the long overlap between 1.4-1.0 myr of Acheulian and Oldowan in Africa (almost half a million years), the absence of any equivalent to the Oldowan in India is perhaps surprising. Peninsular India appears to be the only region occupied during the Lower Palaeolithic where Lower Palaeolithic is equivalent to the Acheulian.

The Acheulian in India, has been divided, on the basis of typology, into an earlier and later phase. The Late Acheulian is found typically in the areas of quartzite bedrock in colluvial rubble deposits away from the major streams. In non quartzite areas the numbers of sites are fewer, but the abundance of artefacts, where they occur, is high. Most of the Early Acheulian sites occur in fluvial deposits, with the best sites sealed within silty or clayey sediments. The site of Chirki, excavated by (Corvinus 1983) is the best documented of this phase. (Pappu 2001)

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has summarized the major Acheulian sites. Paddayya (1982a) reports more than 200 findspots in the Shorapur Doab, the confluence zone of the Bhima and Krishna rivers, located in intensive foot surveys carried out over decades. In the Shorapur Doab, both Early and Late Acheulian occur with most of the occurrences Early Acheulian (Paddayya 1982b).

The typological and technological character of the Early Acheulian in India, closely resembles that of the earliest sites in Africa, discussed previously. Dating of Indian sites is scanty but the available dates do suggest a similar age for the Indian Early Acheulian. An ESR date on enamel from fossil bovids from the Acheulian layer at Isampur indicates an age >1.2 myr (Paddayya et al. 2002). The sites of Bori and Morgaon are associated with a volcanic ash layer which probably is the Oldest Toba Tephra, dated to 800 kyr. The volcanic ash at Bori has been dated to 670 kyr by Ar^{39}/Ar^{40} dating (Mishra *et al.* 1995). Th^{230}/U^{234} dating of a number of Acheulian sites also shows them to beyond the range of the dating method or >400 kyr (Mishra 1992). Palaeomagnetism of Bori and Morgaon as well as Nevasa indicate a Matuyama age (>800 kyr) (Sangode *et al.* 2007). ESR date on calcrete from the Amarpura quarry near Didwana, Rajasthan, which yielded Acheulian artefacts (Misra 1989; Misra *et al.* 1982), is also around 800 kyr (Kailath *et al.* 2000). Thus a lower Pleistocene age is indicated for the Indian Acheulian.

The late Acheulian phase in Peninsular India is best represented by assemblages recovered from the excavation of the Bhimbetka cave (Misra 1978a, 1978b). Bifaces form a small proportion of an assemblage which has a large number of retouched flake tools. Retouched flake tools are almost absent from the early Acheulian.

The Indian subcontinent is one of the areas where *hominins* dispersed in the Lower Pleistocene. *Homo erectus* in Java most probably arrived from the Indian subcontinent as the fossil fauna associated with *Homo erectus* in Java originates from India (Sondaar 1984). While tools are abundant in India and fossils almost absent, the reverse is the case in Java. Early Acheulian assemblages are found in Peninsular India while they are absent from extra Peninsular India. In the Pabbi Hills, sediments dating from 2.2-1.2 myr have only ambiguous evidence for man, while the earlier horizons at Riwat have *in situ* stone artefacts, although few in number. The absence of Early Acheulian from extra Peninsular India and its presence in Peninsular India, favours a dispersal of this technology via Arabia rather than Iran and the Levant. Ecological factors seem to be more important than geographic factors in the distribution of Lower Palaeolithic technologies (Dennell 2004).

China and Southeast Asia

The Lower Palaeolithic of China and Southeast Asia was first characterized as chopper chopping tool industry, by (Movius 1944, 1948). However, the material used to characterize the chopper chopping tool industry was mostly collected from the surface with poor control on its context. The Hoabinian, a Late Pleistocene to Holocene industry in Southeast Asia, is dominated by pebble tools and some of the Lower Palaeolithic pebble tools may belong to this later industry, as in the case of the Soanian, discussed above. The presence of humans in the Lower Palaeolithic period in China and Southeast Asia is better attested by the discoveries of fossils of *Homo erectus*, from a large number of sites, than from the stone tool industries. A large number of *Homo erectus* fossils are known from Java, while in China the number of localities where fossils have been found is over a dozen (Etler 1996). Stone tools however are found in fewer numbers. After over a century of research the nature of the stone tool assemblage associated with *Homo erectus* in Java is still in dispute. The excavations at Naebung, found only a single large flake from a fairly extensive excavation (Simanjuntak and Semah 1996). Recently cut marks made by shell tools have been identified on a number of animal fossils in Java, supporting the idea that low frequency of stone tools could be due to use of other materials (like bamboo and shell) for making tools (Choi and Driwantoro 2007). Stone tools have been found on Flores Island, separated from the nearest land even at lowest sea levels, in sediments below a volcanic ash bed dated to just before the Brunhes Matuyama boundary (Morwood *et al.* 1998, 1999). The dispersal of *Homo erectus* from Java, with stone tools, crossing a water barrier are the inescapable inference from this finding. The Flores tools are small flakes and cores. This population was isolated and led to a dwarf form of hominin, recently discovered in Late Pleistocene cave sediments on the island (Brown *et al.* 2004; Morwood *et al.* 2004).

Recently Chinese archaeologists have distinguished between a pebble/core tool industry in the central-south and the southeast China and a flake tool industry in the north as well as the southwest (Shen and Wei 2004). The flake tool industry of the north and southwest has been considered to belong to the LPMT which is distributed in Central Asia and Central and Eastern Europe. A number of sites in China have been well dated to over a million years old. One of these is the Nihewan basin, where flake tools have been found in sediments dating to 1.2 myr by palaeomagnetism (Løvlie *et al.* 2001, Zhu *et al.* 2001; Zhu *et al.* 2004).

In Southern China, recently, Lower Palaeolithic assemblages with handaxes have been discovered. One of the best documented is the Bose basin, near Kumming (Hou *et al.* 2000). Other localities are Dingcun in Shanxi provinence and Lantian, all in Southern China. At Bose, the handaxes are associated with the Austronesian Tektite layer, within vermiculated red clay. A number of sites have been found and the archaeological material is always associated with the tektite layer. This tektite layer was produced by a meteor impact. The site of the meteor impact has not been identified, but was most probably in Cambodia. The tektites produced by the impact are found over a large area of Southeast Asia and Australia, including the ocean sediments. Both stratigraphy and absolute dating show that the tektites were produced just before the Bruhnes Matuyama boundary.

The handaxes from Southern China are made on pebbles. They are bifacially worked and fit the definition of handaxe. However they are not very similar to the Acheulian in India and Africa due to the lack of cleavers and large flake tools. For this reason Corvinus (2004) and Petraglia (2006) have suggested they are not related to the Acheulian and Hou *et al.* (2000) also label them, not as "Acheulian" but "Acheulian like". It should be noted however that the label Acheulian, originates from the European Acheulian, which also lack cleavers and large flake tools, like the Bose industries. However the Chinese handaxes predate the European ones by a significant amount of time.

Another Lower Palaeolithic industry with handaxes has recently been reported from a number of sites in Korea from Chongokni, Kumpari, Chuwoli and Kawoli in the Imjin/Hantan River Basins. Here the handaxes are dated to around 350 kyr by the identification of a dated volcanic ash layer from the archaeological site (Bae 1992, Norton *et al.* 2006).

Discussion

The immense timespan of the Lower Palaeolithic saw at least two important landmarks in the technological evolution of stone tools. The first is the appearance of stone tools themselves at 2.5 myr and the second is the appearance of the Acheulian technology around 1.4 myr. The earliest *hominin* fossils are found in Africa and date to around 7 myr, close to the supposed divergence of humans from chimpanzees. The earliest stone tools are also from Africa. The earliest fossil *hominins* to be found outside of Africa date to 1.8 myr and are already spread over an area from Java, Indonesia to Dmanisi, Georgia. The first tools in different areas are surprisingly different from each other, which should not be the case if the initial dispersal was at 1.8 myr itself or even associated with the beginning of stone tool manufacture at 2.5 myr. Acheulian technology did not disperse over the entire *hominin* range, indicating that it emerged after the dispersal out of Africa. This may indicate that dispersal events were not triggered by technological advances but rather followed migration into new regions. The first tools might have followed after a pre stone tool making dispersal out of Africa, which might be significantly earlier than the current evidence suggests. The distribution of the Early Acheulian is restricted to Africa, the Middle East and India, while the Late Acheulian dispersed further into the Western and Southern Europe and parts of Central Asia. The Lower Palaeolithic has been discussed primarily as Acheulian and non Acheulian but there are not only considerable differences between Late and Early Acheulian, but also between the non Acheulian traditions. Thus the Oldowan has some differences from the early non Acheulian of Europe which has been called Pre-Oldowan or Mode 1, while the later non Acheulian of Central Europe, Eastern Europe and Asia, previously part of the chopper chopping tool complex, has now have been labeled the Lower Palaeolithic Microlithic Tradition, recognizing the dominance of small tools in most of the assemblages. The developments during this early period are still poorly understood, with new data, discoveries and studies having considerable scope to modify the story as narrated above.

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Prehistoric Antiquities and Personal Lives: The Untold Story of Robert Bruce Foote

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Abstract

Geologist, archaeologist, ethnographer, palaeontologist, museologist and artist. It is not an easy task to define Robert Bruce Foote's contributions in the world of 19th century scholarship in India. A man of many interests, his impressive work established foundations which structured the direction of modern research in Indian geology, and pre-and protohistoric archaeology. The author's ongoing research into the life and work of R.B. Foote, led to the discovery of new information, revealing hidden dimensions of this fascinating personality; a part of which is presented here. This paper puts forward, for the first time, information on Robert Bruce Foote's lineage and family history, and traces how personal lives were intertwined with the quest for India's past.

> *"And I appoint my dear wife Eliza Melissa Foote during her life and after her death my trustees to be the guardian and guardians of my infant children. I give (excepting my collections of Indian Prehistoric Antiquities or the proceeds thereof which shall form part of my general estate and the articles hereinafter specifically bequeathed) all my plate, linen, china, glass, books, pictures, prints, wines, liquors, furniture and other household effects and all my carriages and horses to my said wife absolutely".*
>
> *(Extract from the Will of R.B. Foote 1899)*

In Search of a Hidden History

Prehistoric antiquities are a particularly unusual item to be listed in one's last Will and testament. Perhaps not so in the case of personalities such as that of Robert Bruce Foote, whose life was intimately linked with the many worlds of India's ancient past. His name is stamped across the pages of India's geological and archaeological history, and carries as much weight today as it did a century ago. References to his work form a thread of continuity linking crumbling pages of 19th century journals and reports, with doctoral dissertations and articles churned out today. His prolific publications comprising reports, memoirs, short notes, and catalogues of antiquities, his lectures and his dialogues with interested individuals, geologists and other scholars; place him amongst the foremost intellectuals of the late 19th century. A man of multiple interests and talents, Foote combined in himself the precision of a scientist, with intuitive insights of a man who was deeply involved in the past and present of the land in which he lived. Foote belonged to a time when boundaries did not limit a scholar's interest in the world around him (Grayson 1983; Levine 1986; Sangwan 1994; Wyse Jackson 2007). From observations on geology and archaeology, to those on anthropology and palaeontology, Foote was equally proficient in whatever he chose to investigate. His convincing establishment of the presence of Palaeolithic cultures in India, (Foote 1866) followed by his extensive documentation of pre- and protohistoric sites in various parts of southern and western India have been aptly summarized elsewhere (Chakrabarti 1979; Ghosh 1963; Khatri 1962; Pappu 1991-92, 2001, 2004, 2007; Paddayya 2004, 2007; Patil 2004; Sen and Ghosh 1966; Sundara 2004).

In addition to a host of archaeologists who followed in his footsteps (see Chakrabarti 1979; Sundara 2004); Foote's contributions were also recognised by his contemporaries and this is seen in the form of reviews of his notes, reports and memoirs and publications, in unpublished documents, as well as in obituaries (Oldham 1913: lxv-lxvi; Haydon 1913, J.M. (anon. review) 1883:313). In addition to praising his geological research, Oldham (1913) in his obituary, specifically refers to him as, '...a most enthusiastic investigator of relics of ancient man in Southern India; ....and was for long recognised as a leading authority on this branch of research..'. It is well known that Foote worked at a time when critical questions on human antiquity, as well as on geological processes, were the focus of interest in the west, with Jacques Boucher de Crevecoueur de Perthes, H.H. Falconer, Joseph Prestwich, Charles Lyell, Thomas Huxley, Rupert Murchison, amongst many others, playing an

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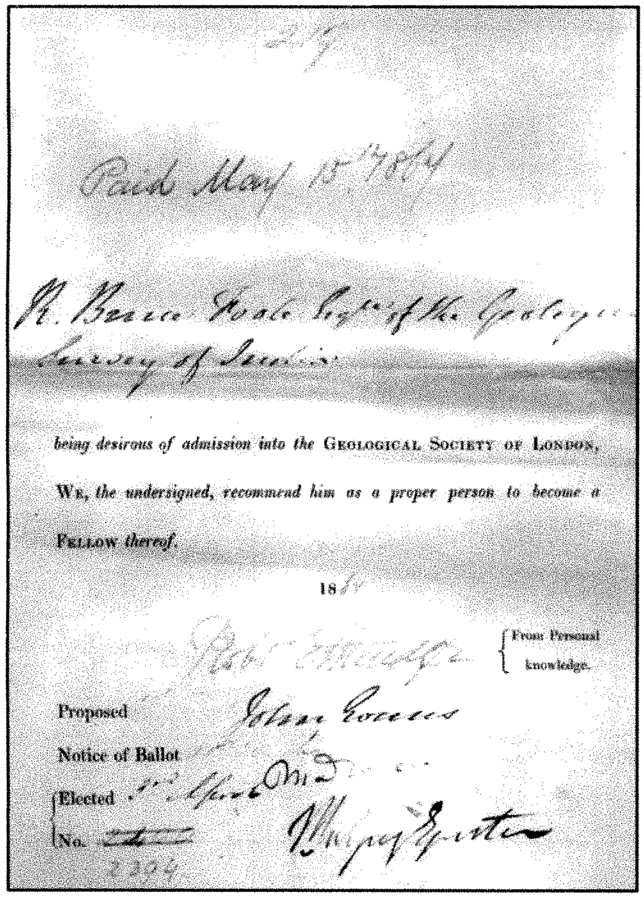
* These are catalogue numbers of the documents and photographs (original and copies) in the Sharma Centre for Heritage Education, Chennai

important role (Grayson 1983). It is less well known that Foote's international renown is seen in his communication with many of these scholars who discussed his papers, noted his observations in the context of their own discoveries, and sought his collections for purchase or for museums (Pappu 2001, manuscript in preparation).

Apart from his research, little information on Foote is available. In 1979, Chakrabarti (1979:13) admitted that we know very little of his professional life. As late as 2007, Paddayya (2007) commented that no information was available on his family and educational background. Original sources enable us to draw a brief outline of the principal phases in Foote's long and successful career (Archer 1969:197-198; Haydon 1913; India Office List 1894:257; Oldham 1913: lxv-lxvi). Summarising available information, we note that he was born in 1834, was appointed from England as an assistant in the Geological Survey, and joined on 28th September, 1858. Documents obtained by the author, show that he was an elected Fellow of the Geological Society[1] of London (No. 2394), as early as 3rd April, 1867 (Fig. 1). His name was proposed on 6th March by none other than John Evans and Robert Etheridge. He served in various districts of the Madras Presidency, the Nizam's territory, and Bombay, and was later deputed to the Vienna Exhibition in joint charge of the Survey collections in 1873. He was made a 1st grade officer, in April 1876, and Deputy Superintendent in June 1881; a Fellow of the Madras University and member of the Faculty of Engineering in 1884. He was also a Corresponding Fellow of the Geological Society of Edinburgh. His designation was changed to Superintendent of Survey in September 1885; he officiated as director in 1887; and retired in October, 1891 to settle at Yercaud, Tamil Nadu. He died at Kolkata (Calcutta) on 29th December, 1912, details of which will be discussed later in this paper. After retirement he was appointed as the State Geologist at Baroda, and later as Director to organize the State Geological Service in Mysore in 1894.



Paid May 15th 1867

R. Bruce Foote Esqr of the Geological Survey of India

being desirous of admission into the GEOLOGICAL SOCIETY OF LONDON,

WE, *the undersigned, recommend him as a proper person to become a* FELLOW *thereof.*

18

Robt Etheridge { From Personal knowledge.

Proposed John Evans

Notice of Ballot

Elected 3rd April 1867

No. 2394

Fig. 1: Certificate admitting R.B. Foote as a Fellow of the Geological Society, London (Courtesy, Geological Society of England)

Who was Robert Bruce Foote?

Through the years, literature written by and on Foote, help us gain insights into his personality- as a scientist and scholar and as a man standing in front of India's past with a sense of wonder and reverence. But who was Robert Bruce Foote? In this context, it may be noted that genealogical studies investigating links and connections between people working in Indian geology and archaeology in the 19th century are a powerful way of examining the history of a discipline. A good example is that of H.H. Falconer, whose niece Grace McCall later married his collaborator, Joseph Prestwich. She maintained records of correspondence and documents, preserving important evidence of ongoing debates in the quest for human antiquity (Boylan 1979). In the case of Robert Bruce Foote, in addition to his enormous energy and personal effort, many of his discoveries were inextricably linked to a network of supportive family members and friends.

In the course of researching the life and work of Robert Bruce Foote (Pappu 1991-92, 2001, 2004, 2007, manuscript in preparation), the author was fortunate to establish contact with his grandson, Dr. John B. Foote, the son of Henry Bruce Foote (SCHE/RBF/01/02/03/04*). The Foote family kindly invited the author to meet them, and in the course of mutual correspondence over the years, they were of immense help in providing rare documents and photographs. Subsequently, the author came into contact with Mrs. Florence Ashton, whose great-great-grandfather, John, was the brother of Revd. Peter P. Percival (Robert Bruce Foote's father-in-law), and who provided valuable insights and information on both the Percival and Foote families (SCHE/PER/01/02). Further information was provided by the Late Mr. Tate, who resided for many years in Yercaud, and who was possibly one of the last living individuals in India, who actually remembered Foote. This information was substantiated and supplemented by research in archives and libraries in India and the U.K. Of the vast body of information gathered, this paper presents details which are specifically related to the genealogy and family history of Robert Bruce Foote. In his quest to unravel the mysteries of India's prehistory, we see a tale of great discoveries interwoven with the many joys and tragedies of family life.

Early Ancestors

To begin with, we travel back in time to the 14th century, to William of Wykham, to whom the Foote family trace their ancestry on the side of Robert Bruce Foote's mother, Sophia Wells (Fig. 2). William of Wykham or William Wykeham, (1323-1404), was an English Lord Chancellor and bishop of Winchester. Some information is available on him and he played a crucial role under several kings, involving in both secular and ecclesiastical affairs (see references from http://www.1911encyclopedia.org/William_ Of_Wykeham). In his eventful career, he bought endowments for Winchester and New College, founding "Seinte Marie College of Wynchestre by Wynchestre" in 1388. Figure 2, provides an abridged list of descendents of William of Wykham as traced down to Robert Bruce Foote's parents.

Parents, Siblings, and the Birth of Robert Bruce Foote

Robert Bruce Foote's mother, Sophia, was the third daughter of Diana Giffard a descendent of William of Wykham, who married Jonas/Jonah Smith Wells of Highgate on 9th June 1826, at Hornsey (Figs. 2-3) (Gentleman's Magazine, 1826; courtesy Florence Ashton). Sophia's brother, Giffard Wells, married Mary Anne Beadilieu. In a strange twist of fate, their daughter Eliza Melissa Wells, later become the second wife of Robert Bruce Foote, and as is seen later, their youngest son was named Giffard Wells Bruce Foote after his grandfather. Foote's mother is referred to as Sophia C. Foote, and listed as one of the witnesses of R.B. Foote's wedding on 7th June, 1862. Sophia Foote died in 1868. She is also mentioned in census reports along with information on her sister and her son (Pappu manuscript in preparation).

Robert Bruce's paternal grandfather was Dr. Henry Wells Foote, a doctor who died on 11th March, 1828. An interesting piece of evidence is seen in correspondence between Robert Bruce's grandchildren, (children of Henry Bruce Foote and his first wife Jeanie Jessett). In a letter[2] from 'Hal' (Major-General H.R.B. Foote) to Vera Violet Jeanie dated 18th June, 1964, 'Hal' states that that Dr. Henry Wells Foote probably became a member of the Plymouth Bretheren, a group of conservative Christians, during the last five years of his life. He died at about 45 years of age. Although this is unsubstantiated, family history mentions that Robert Bruce Foote did not agree with their philosophy, and rejected them. Robert Bruce's father, Dr. William Henry Foote (Fig. 3), was a medical practitioner, who as per family history, was trained under Rene Theophile Hyacinthe Laënnec (1781–1826),

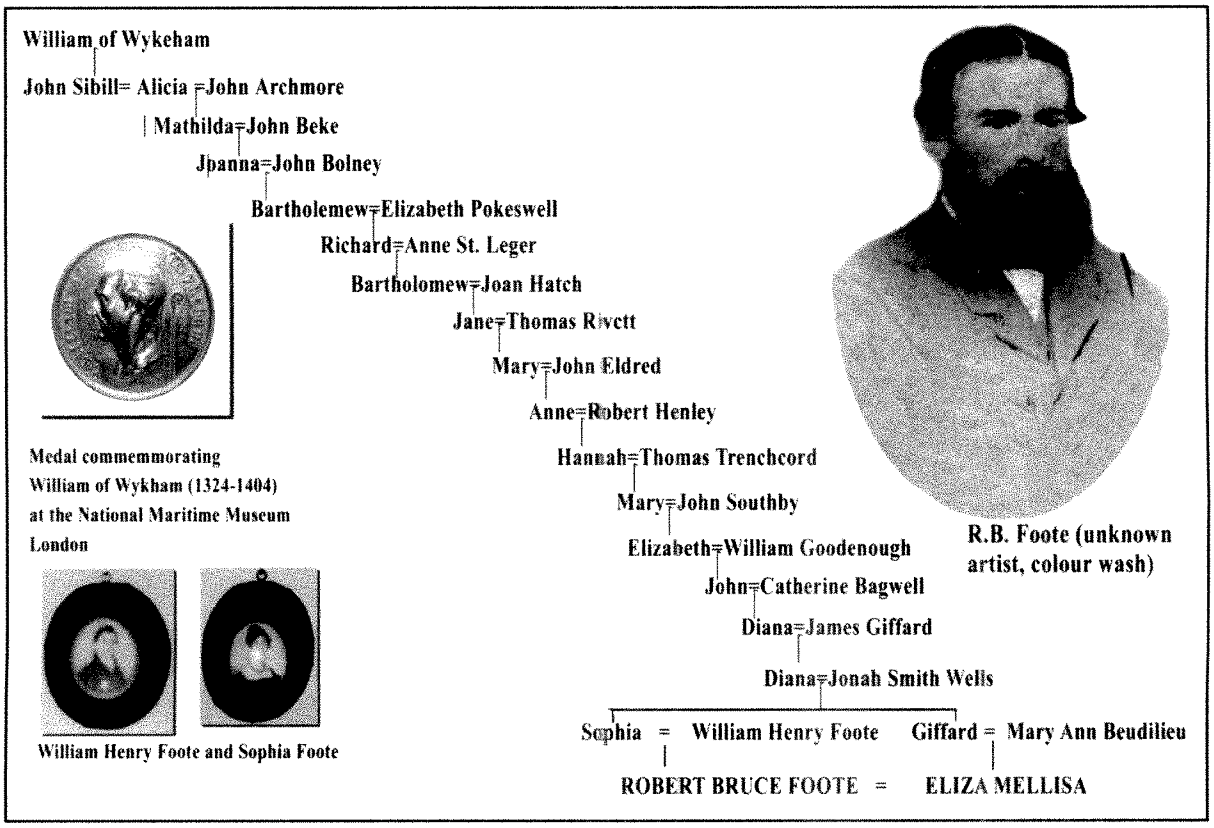

William of Wykeham
John Sibill= Alicia =John Archmore
Mathilda=John Beke
Joanna=John Bolney
Bartholemew=Elizabeth Pokeswell
Richard=Anne St. Leger
Bartholomew=Joan Hatch
Jane=Thomas Rivett
Mary=John Eldred
Anne=Robert Henley
Hannah=Thomas Trenchcord
Mary=John Southby
Elizabeth=William Goodenough
John=Catherine Bagwell
Diana=James Giffard
Diana=Jonah Smith Wells
Sophia = William Henry Foote
Giffard = Mary Ann Beudilieu
ROBERT BRUCE FOOTE = ELIZA MELLISA
Medal commemmorating William of Wykham (1324-1404) at the National Maritime Museum London
R.B. Foote (unknown artist, colour wash)
William Henry Foote and Sophia Foote

Fig. 2: Early Ancestors: Abridged list of descendents of William of Wykham. (Insets: NSET: E8097-1, Medal commemorating William of Wykham (1324-1404); obverse © National Maritime Museum, Greenwich, London, image from *http://www.nmm.ac.uk/collections/explore/object.cfm?ID=MEC3019;* Early colour wash of R.B. Foote (courtesy, J.B. Foote); Portraits of William Henry and Sophia Foote (Courtesy, J.B.Foote)

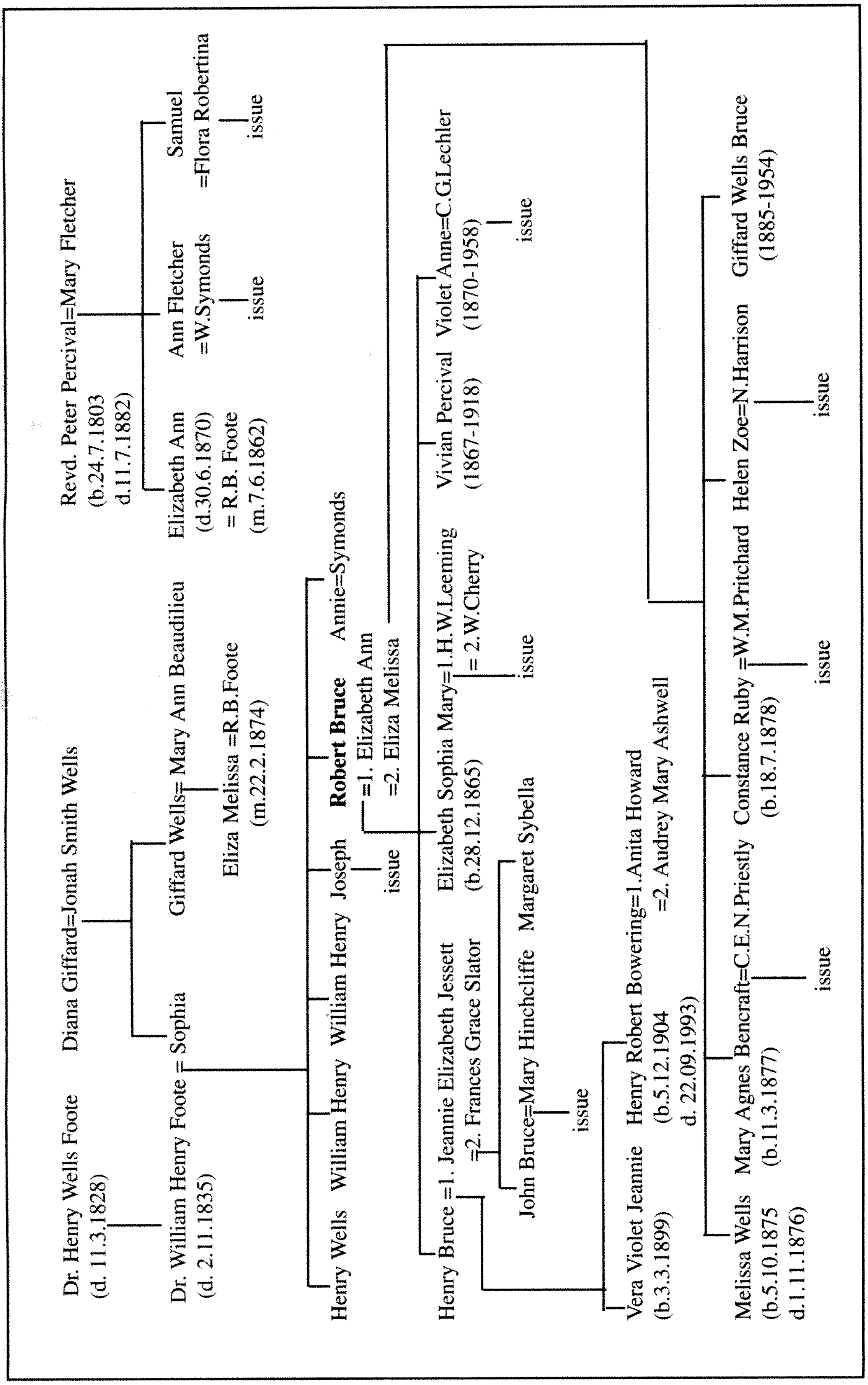
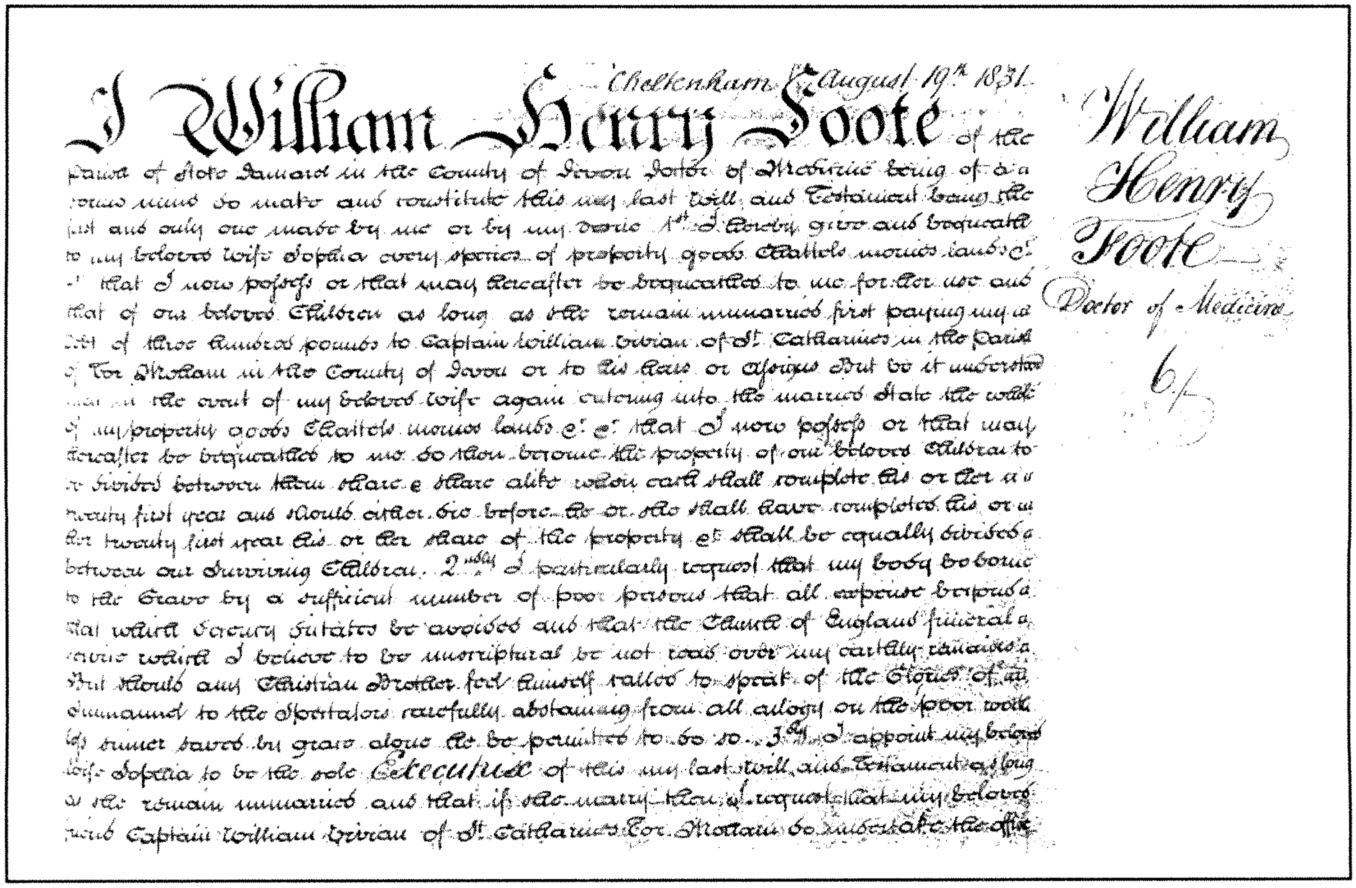

Dr. Henry Wells Foote (d. 11.3.1828)
Diana Giffard=Jonah Smith Wells
Revd. Peter Percival=Mary Fletcher (b.24.7.1803 d.11.7.1882)
Dr. William Henry Foote = Sophia (d. 2.11.1835)
Giffard Wells=Mary Ann Beaudilieu
Eliza Melissa =R.B.Foote (m.22.2.1874)
Elizabeth Ann (d.30.6.1870) = R.B. Foote (m.7.6.1862)
Ann Fletcher =W.Symonds
issue
Samuel =Flora Robertina
issue
Henry Wells
William Henry
William Henry
William Henry
Joseph
issue
Robert Bruce =1. Elizabeth Ann =2. Eliza Melissa
Annie=Symonds
Henry Bruce =1. Jeannie Elizabeth Jessett =2. Frances Grace Slator
Elizabeth Sophia Mary=1.H.W.Leeming = 2.W.Cherry (b.28.12.1865)
issue
Vivian Percival (1867-1918)
Violet Anne=C.G.Lechler (1870-1958)
issue
John Bruce=Mary Hinchcliffe
issue
Margaret Sybella
Vera Violet Jeannie (b.3.3.1899)
Henry Robert Bowering=1.Anita Howard =2. Audrey Mary Ashwell (b.5.12.1904 d. 22.09.1993)
Melissa Wells (b.5.10.1875 d.1.11.1876)
Mary Agnes Bencraft=C.E.N.Priestly (b.11.3.1877)
issue
Constance Ruby =W.M.Pritchard (b.18.7.1878)
issue
Helen Zoe=N.Harrison
issue
Giffard Wells Bruce (1885-1954)

Fig. 3: Abridged family tree of Robert Bruce Foote (b.22.09.1834, d.29.12.1912)



Cheltenham August 19th 1831.

I William Henry Foote of the
Parish of Stoke Damarel in the County of Devon Doctor of Medicine being of a
sound mind do make and constitute this my last Will and Testament being the
first and only one made by me or by my desire 1st I hereby give and bequeath
to my beloved wife Sophia every species of property goods chattels monies lands &c.
&c. that I now possess or that may hereafter be bequeathed to me for her use and
that of our beloved Children as long as she remain unmarried first paying my
bt of three hundred pounds to Captain William Vivian of St. Catharines in the Parish
of Tor Mohun in the County of Devon or to his heirs or assigns But be it understood
at in the event of my beloved wife again entering into the married State the whole
of my property goods Chattels monies lands &c. &c. that I now possess or that may
hereafter be bequeathed to me do then become the property of our beloved Children to
be divided between them share & share alike when each shall complete his or her
twenty first year and should either die before he or she shall have completed his or
her twenty first year his or her share of the property &c. shall be equally divided a
between our surviving Children. 2ndly I particularly request that my body be borne
to the Grave by a sufficient number of poor persons that all expense beyond a
that which decency dictates be avoided and that the Church of England funeral
service which I believe to be unscriptural be not read over my earthly remains.
But should any Christian Brother feel himself called to speak of the Glories of an
Emmanuel to the Spectators carefully abstaining from all eulogy on the poor worth
less sinner saved by grace alone he be permitted to do so. 3rdly I appoint my beloved
wife Sophia to be the sole Executrix of this my last will and Testament as long
as she remain unmarried and that if she marry then I request that my beloved
friend Captain William Vivian of St. Catharines Tor Mohun do undertake the office

William Henry Foote
Doctor of Medicine

6/

Fig. 4: Extract from the Will of Dr. William Henry Foote (The National Archives, Public Record Office, Catalogue Reference:Prob 11/1853. Image Reference: 415)

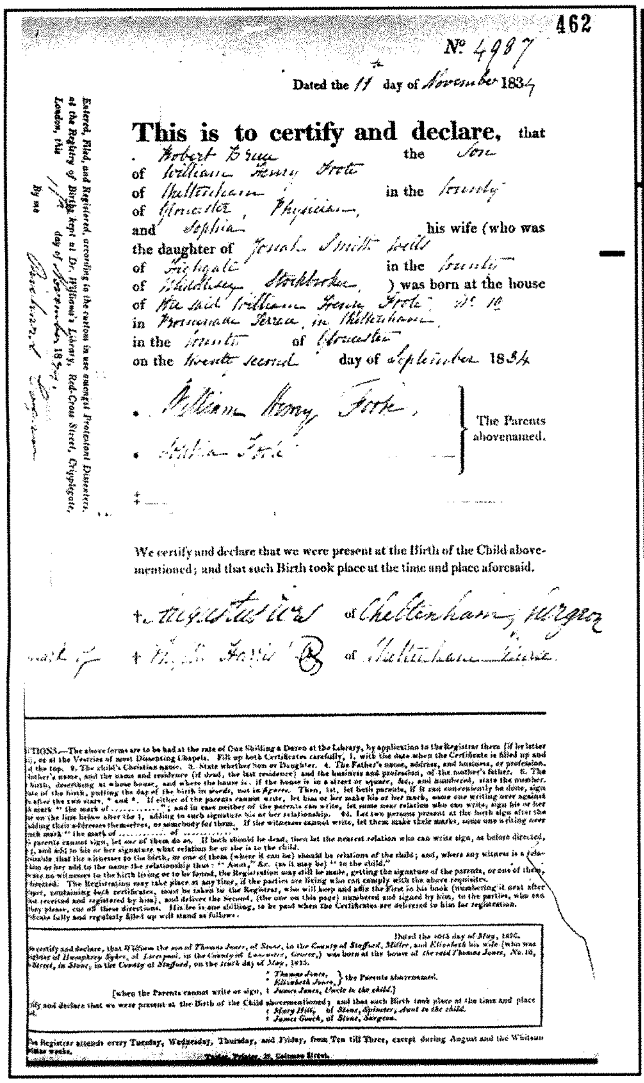
reputed to be the inventor of the stethoscope (Roguin, 2006). A copy of the Will of William Henry Foote[3] (Fig. 4), records him as having died on 2nd November, 1835, and lists him as hailing from Devon. He bequeathed all his property to his wife Sophia. This implies that Robert Bruce was just a year old, when his father died. Reference in the Will to a dear friend, Captain William Vivian, is interesting, insofar as both Robert Bruce Foote's brother, and later his son, bore the name Vivian - perhaps in memory of this dear friend?

Some information on Robert Bruce's siblings is seen in a document dated 5th September, 1855[4], which makes out a Grant of Arms to a Henry Wells Foote, of Harrington Square in the Parish of St. Pancras, Co. Middlesex. He is described as a Gentleman and son of William Henry Foote. The latter is listed as Late of Cheltenham Co. Glouster, Doctor of Medicine, Licentiate of the Royal College of Physicians of London. The Grant of Arms was made out to Henry Wells Foote and other descendents of William Henry Foote. The descendents included Robert Bruce Foote, his brothers Henry Wells, William Henry, another William Henry, William Vivian, and yet another William Henry, and a daughter. This Grant made over the Arms which comprised;

'Gules two Chevronels Or Between as many Doves in chief and a Cross patee in base Argent', and the Crest which had 'Two Crosses patee fitchee in saltire Gules thereon a Pelican in her Piety Argent wings fretty Gules'.

The family tree provided by the Foote family, records Robert Bruce Foote, a brother Joseph, who later became a lawyer, and a sister Annie who married a Mr. Symonds and their offspring (Fig. 3). There is no mention of other brothers, although a Henry Wells Foote, is reported as having been born at the house of Shernad Hurt, No. 41, Beaumont Street, London on March 16th 1828. As seen later, Robert Bruce Foote, mentions a beloved brother 'Hal' in his Will. The 1851 census records mention the son of Sophia Wells Foote, as Henry Wells Foote, aged 22, stock and share broker, born at Marleybone.

It was into this illustrious family that Robert Bruce Foote was born on 22nd September 1834. His birth certificate[5] (Fig. 5) records that he was born at home, which was 10 Promenade Terrace, Cheltenham. This town in Gloucester, England, has an interesting history, and at the time of Foote's birth, was a spa town and a tourist destination. The Promenade is reported to have been laid out and developed by the 1820's. His early life and education are dealt with elsewhere (Pappu manuscript in preparation); and we take up the story with his arrival in India.



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No 4987

Dated the 11 day of November 1834

Entered, Filed, and Registered, according to the custom in use amongst Protestant Dissenters, at the Registry of Births kept at Dr. Williams's Library, Red-Cross Street, Cripplegate, London, this day of November 1834. By me

This is to certify and declare, that
Robert Bruce the Son
of William Henry Foote
of Cheltenham in the County
of Gloucester, Physician,
and Sophia his wife (who was
the daughter of Josiah Smith Wells
of Highgate in the County
of Middlesex, Stockbroker,) was born at the house
of the said William Henry Foote, No 10
in Promenade Terrace, in Cheltenham.
in the County of Gloucester
on the twenty second day of September 1834

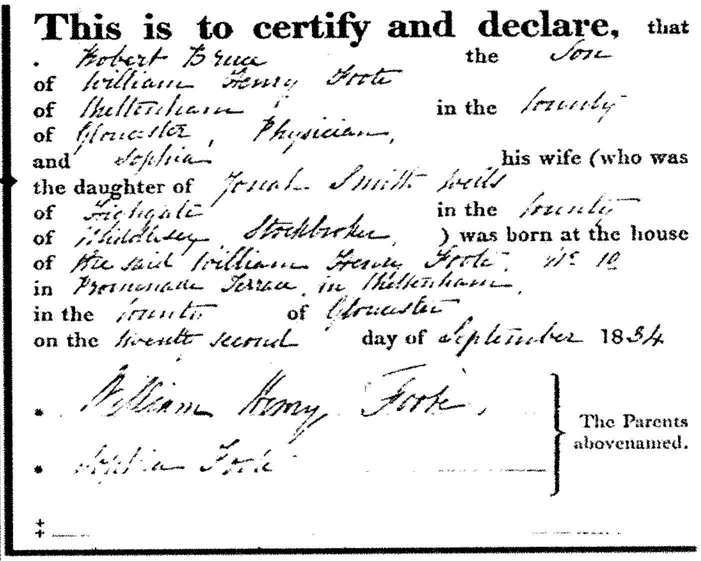
William Henry Foote,
Sophia Foote
} The Parents abovenamed.

We certify and declare that we were present at the Birth of the Child abovementioned; and that such Birth took place at the time and place aforesaid.

+ of Cheltenham, Surgeon
+ of Cheltenham Nurse

Dated the 16th day of May, 1826.

The Registrar attends every Tuesday, Wednesday, Thursday, and Friday, from Ten till Three, except during August and the Whitsun weeks.



This is to certify and declare, that
Robert Bruce the Son
of William Henry Foote
of Cheltenham in the County
of Gloucester, Physician,
and Sophia his wife (who was
the daughter of Josiah Smith Wells
of Highgate in the County
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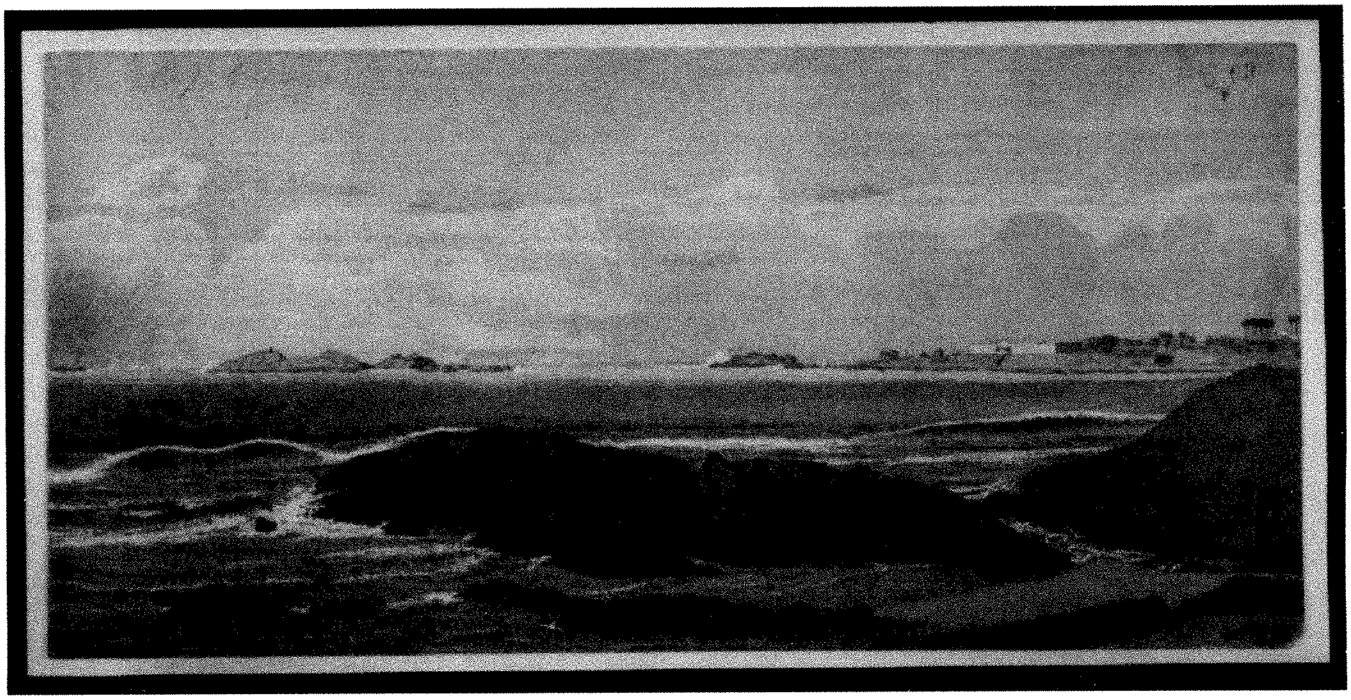
in Promenade Terrace, in Cheltenham.
in the County of Gloucester
on the twenty second day of September 1834

William Henry Foote,
Sophia Foote
} The Parents abovenamed.

Fig. 5: The birth certificate of Robert Bruce Foote (Record No. 4987. Registry of Births, Dr. Williams Library, London. (Courtesy, Mrs. Florence Ashton). Inset is an enlargement of the same showing details

Fig. 6: Robert Bruce Foote's pen and ink and wash entitled 'View of Cape Comorin, the Kumla Kumari Pagoda, and islands-from a point 1¼ miles N.E of the Cape', which is dated 18.9.1860 (Oriental and India Office Collections, British Library)



Arrival in India and the 'Kumla Kumari Pagoda'

As a young geologist joining the Geological Survey of India on 28th September, 1858 (India Office List 1894: 57), Foote could never have anticipated the strange fate that was to establish his fame, and change the course of Indian geology and archaeology. In 1857, a year before he arrived in India, C.Æ. Oldham, W. King, and H.F. Blanford, were deputed along with H. Geoghegan, to take up the survey of the Madras Presidency in order to examine the Cretaceous rocks known to exist in Trichinopoly and South Arcot and to obtain, if possible, a fixed geological and palaeontological horizon, establishing a datum to situate sedimentary rocks discovered. H. Geoghegan died of sunstroke in 1858, and Foote was appointed as his replacement (Foote 1882).

We can only imagine the impact which India had on him in the first years after his arrival. At this early stage, he was still struck by the beauty of the landscapes he encountered, which he translated into a work of art. This is seen in the form of a painting of a seascape entitled, 'View of Cape Comorin, the Kumla Kumari Pagoda, and islands-from a point 1¼ miles N.E of the Cape', which is dated 18.9.1860, and done in pen and ink and wash (Fig. 6), (Archer 1969:197-198; Oriental and India Office Collections, purchased with the Sir Henry Yules Collection). Although his geological work in this region was conducted later (Foote 1883), his early surveys led him to study the southern districts of Tamil Nadu (King and Foote 1864), and a visit to Kanya Kumari was possibly undertaken. This depiction of a tranquil seascape, was in striking contrast to the hardships he faced from the vagaries of an often cruel and harsh environment in the course of his surveys, and which he described in great detail in a paper published years later (Foote 1882).

Introduction to Indian Culture: The Percival Connection

Robert Bruce Foote's first wife was Elizabeth Ann Percival, more of whom will be discussed later. Foote's choice of a wife, perhaps throws some more light on his early interest in Indian culture and history. Elizabeth Ann, was the daughter of the renowned scholar, educationist, architect and missionary, Revd. Peter Percival. The importance of Revd. Peter Percival in Foote's life cannot be underestimated, and it is in this context that the former's contributions may be briefly summarized below. Revd. Percival married Mary Fletcher on 13th December, 1824 at Prestwich, Lancashire, England, and soon after sailed to Sri Lanka. Starting his career as a Wesleyan Missionary, the Revd. Percival was first in charge of the Mission Institute or College at Jaffna, where his contribution is still remembered (Fig. 7). He arrived at the Jaffna Wesleyan English School in 1826 and in 1834 renamed it as The Jaffna Central School. Mrs. Percival is credited with starting a boarding school for girls in 1834. The couple contributed greatly towards education for girls in Sri Lanka. In addition to this scholarship; he was also an architect and was the first to renovate St. Peter's Church in 1937, as well as the Lutheran church, which was called St. Pauls. He later moved to Madras, severed ties with the Wesleyans, and became Registrar of Madras University, and Professor of Vernacular Literature in the Presidency College. He joined the Church of England and was ordained at Ootacamund. In addition to this, he was also for some years a Chaplain of the Madras Military Female Orphan Asylum.

Fig. 7: Revd. Peter Percival (Courtesy, F. Ashton) (1803-1882)

Revd. Percival was a noted Tamil scholar and he published the first Tamil translation of the Bible. His book *Land of the Veda: India Briefly Described In some of its Aspects, Physical, Social, Intellectual and Moral* (Percival 1854), was published a few years before Foote landed in India. However, based as it was on a series of lectures delivered at the St. Augustines Missionary College, Canterbury; one may speculate as to whether Foote was already aware of his views. He is also credited with a renowned book on Tamil proverbs, first published in 1842, followed by a revised edition in 1874 (Percival 1874), an Anglo-Telugu dictionary (1867), an Anglo-Tamil dictionary (1938), and aphorisms of the poet-saint Auvayar, amongst other works. During this period, he was also busy preparing maps and books in the vernacular languages for the Director of Public Education. He is credited with starting the Tamil journal *Dinavartamani*, (Percival 1874), organized by the Civil and Military Services of Government, aimed at diffusing amongst the Tamil people, social, political, and literary information, and which was first brought out in 1855. Soon after, he started a Telugu journal of the same name. The address of the Dinavartamani Press is listed as being located at Little Bourne, Luz, Mylapore, and this was the Percival residence as well. It is interesting to note that this residence witnessed the birth of Robert Bruce Foote and Elizabeth Ann's first daughter, Elizabeth Sophia Mary and later the death of Elizabeth Ann. Revd. Percival later retired to Yercaud. He was shattered by the death of his son, Revd. Samuel Percival, in 1881 and died a year later on Tuesday, 11th July, 1882, at Yercaud, Tamil Nadu (obituary, 1882; Will of Revd. P. Percival 1882; see *Online Sources*; personal communication, F. Ashton).

It is into this illustrious family that Robert Bruce Foote married. In the small British community at Madras, it is very likely that Foote was influenced by, or drawn to Revd. Percival by their common interest in the culture and history of India. Revd. Percival had commented on the great variability in the, '...operation of race, language, religion, and climate, upon the character and social usages of the Hindus who occupy the vast area of India that it is unsafe to assume generally that what is common in one Province is so in others..' (Percival 1874:preface). It is tempting to believe that this is perhaps reflected in Foote's later recognition and emphasis on understanding the geographic and regional variability seen in the pre- and protohistoric communities of India (Foote 1916a). We can only speculate as to whether the two were brought together by their common interests and whether this was how he met his wife.

Revd. Percival's second daughter, Anne Fletcher, married William Alfred Symonds, on 11th July, 1882[6]. Symonds is listed as being a bachelor, Assistant Director, Revenue Settlement Service, and son of Alfred Radford Symonds. Both were reported as living in Madras, and witnesses were listed as P.Percival, H. S. Smith and Alice B. Symonds. Symonds, later went on to become Superintendent Prisons, Madras; and is mentioned several times in Foote's writings and in his Will. In addition to this, Symonds was also noted for his study of Tamil proverbs (Percival 1874). Surrounded by scholars, one may presume that Foote must have been proficient in Tamil and Telugu, and thus able to communicate effectively with local villagers in his quest for antiquities and sites. Both Foote and Percival retired to the pleasant hill station of Yercaud in their later years, and it is very possible that Revd. Percival was the main factor influencing Foote's later decision to retire here.

Foote's close relationship with Revd. Percival, was sustained long after the death of Elizabeth Ann as is evident in their Wills[7] (Will of Revd.P. Percival 1882; Will of R.B. Foote 1899, codicil 1908). Revd. Peter Percival's last Will and testament, gave the power of making grants to both his sons-in-law, Robert Bruce Foote and William Alfred Symonds (dated 8th August 1882). When Revd. Percival died, Foote was in fact, in the midst of his surveys in the Tirunelvelli district (Foote 1883). Revd. Percival describes himself in the Will as being from Luz, and a Clerk in Holy Orders. Amongst other interesting details, he mentions one of his executors to be Robert Bruce Foote of the Geological Survey of India. While discussing details of various bequests and legacies, he mentions property given by him during his lifetime to Robert Bruce Foote, to be held in trust for his grandchildren by Foote's first wife (i.e. his daughter, Elizabeth Ann). The long standing relationship with the Percival family, is seen in the fact that as late as 1879, Foote is listed as a witness to the wedding of Revd. Percival's granddaughter, Mary Flora Elizabeth who married Henry Allan at Nagapattinam[8]. Revd. Percival is also seen as the officiating minister at the baptisms of many of Foote's children.

Stone Tool Illustrations and Elizabeth Ann Foote

A year before his famous discovery of stone tools at Pallaveram, Foote married Elizabeth Ann Percival[9], on the 7th of June, 1862. The marriage record lists him as being a bachelor, an Assistant Geologist in the Geological Survey at Madras, and the son of William Henry Foote. The marriage was at St. Thome' (St.Thomas), Madras, and they were married by the Revd. A.S. Symonds. Witnesses included Foote's mother, listed as Sophia C. Foote, and his best friend and colleague, William King (Fig. 3).

Shortly after Foote's phenomenal discoveries of tools at Pallaveram and around Attirampakkam, he published his first major paper on these discoveries (Foote, 1866). This paper, had its origin in a lecture delivered at the Royal Institution on 26th February, 1864, and was supplemented by a number of illustrations of stone tools. In this paper, he confessed that his knowledge of stone tools was limited to illustrations in 'The Geologist'. The author's studies indicate that this possibly refers to the article by S.J. Mackie, F.G.S, F.S.A, published in 'The Geologist', no.35, 37, and later in a book *Cheap Popular Scientific Diagrams', Explanation of Diagram No. VI. Flint Implements from the Drift*, in the year 1861. He commented that he felt '...a little doubtful therefore in unhesitatingly regarding my find as a genuine Stone Implement, so contented myself with mentioning it in a letter to my friend and colleague William King and showing it to different members of my family..'(Foote, 1866: 2-3). Years later, while referring to this paper, Foote wrote in a grateful observation that, '....the great majority of the 27 plates illustrating my paper were drawn by my wife and are excellent likenesses of the implements though very coarsely lithographed...' (Foote, 1916a:109). However, tragedy struck in the midst of all this excitement. On 30th June, 1870, Elizabeth Ann died at Little Bourne, Luz, Madras, of an abscess in the liver, and was buried in St. George's Cemetery (1st July 1870). She left behind four infant children, seven year old Henry Bruce, five year old Elizabeth Sophia Mary, three year old Vivian, with the youngest Violet Anne, being only a few months old (Fig. 3). Foote was left a widower with four young children, whilst in the midst of his survey of remote regions in the southern part of the Madras Presidency. In Foote's long history of prolific writing, we find only one short note published in 1870 (Foote 1870), although there is no trace of this tragedy or the difficulty of raising small children, in any of his later writings. The children of Elizabeth Ann and Robert Bruce Foote play an important role in the events which were to unfold in Foote's life, as discussed below.

'Palaveram', 'Atrampakkum', Billa Surgam and Henry Bruce Foote

The year 1863 proved to be particularly special for Robert Bruce Foote. His discovery of a Palaeolithic artefact at Pallaveram, occurred on 30th May, 1863. The joy of this

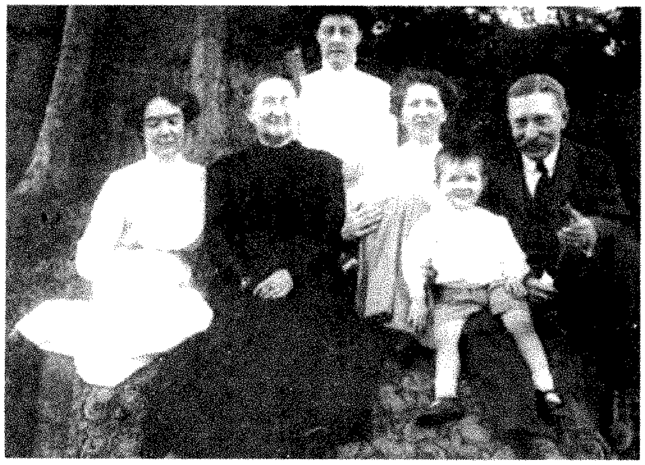


Fig. 9: Henry Bruce Foote with other family members

Fig. 10: Henry Bruce and Frances Grace Foote at Ishapore

discovery (Foote 1866), came almost immediately after the birth of his eldest and favourite son, Henry Bruce Foote. Birth records[10] list Henry Bruce, son of Robert Bruce Foote and Elizabeth Ann, as born on April 22nd, 1863, and baptized on May 24th, 1863 (Fig. 3). He was born at Hope Villa, Luz. Foote is listed as Assistant Geologist, Geological Survey of India. The baptism was kept within the family, with Revd. P. Percival, the baby's grandfather, being the officiating minister. In the same year, Foote and King discovered tools at Attirampakkam on 28th September, 1863. It is perhaps fitting that Henry Bruce Foote, who later went on to excavate and survey the famous cave complexes at Billa Surgam in Andhra Pradesh, was born in the midst of discoveries which not only changed the face of Indian archaeology, but which played an important role in the ongoing debates on the antiquity of humanity in the west.

Of all his children, Robert Bruce Foote, had a great deal of affection for his first born son. This is discussed later, when we examine his Will, but it is also seen in the close companionship built up in the course of their common interest in archaeology. Henry Bruce Foote had an illustrious career. He was a Gentleman Cadet Royal Military Academy, Woolwich, on 1st October, 1880, a Lieutenant on 1st October, 1882, Captain (12th October, 1891), Major (1st April, 1900), and Lieutenant-Colonel (1st April 1911). He was transferred to the Indian Ordnance Department in March, 1893, and was Superintendent of the Ishapore Rifle Factory (Ishapore, West Bengal), from 6th January, 1904. He was also posted as Assistant Director, Ordnance Inspection, on 30th March, 1904, in Nainital, and was appointed Assistant Ordnance Collecting Officer for India, on 11th October 1917, after which he spent time between India and England (Figs. 9-10). He retired with pay on Indian pension (7th September, 1919), and died at Farnham Common, on 8th June, 1932.

Henry Bruce Foote is the most well known amongst archaeologists, primarily owing to his work in the Billa Surgam caves, Andhra Pradesh (Foote 1884a, 1884b, Murty 2004). During his leave, Henry accompanied Robert Bruce Foote when the latter was asked to investigate the Billa Surgam caves and follow up the work of Capt. Newbold as instructed by Grant Duff, the Governor of Madras. Robert Bruce and Henry Foote, proceeded to the Kurnool area, but Foote's information on the location of Billa Surgam proved to be wrong. He could thus only work at Yerra Zari Gabbi and did not meet with any success (Foote 1884, 1916a:191). Father and son later discovered the exact location of Billa Surgam (Foote 1916a : 191). In 1884, he was called off for other work, but as Grant Duff, the Governor of Madras was very keen to continue the work, it was entrusted to his son, Henry Bruce Foote. A Lieutenant in the Royal Artillery, Henry Bruce was temporarily attached to the Department, and took up excavations at Billa Surgam, where it had been left off by his father. Henry had already spent several weeks with his father, and Foote writes that he, '...had afforded me great assistance in exploring and excavating different caves, and had thereof gained a knowledge of the country and of the people whom he had to employ in the further explorations' (Foote 1884b : 200). Henry worked from March till May, commenced excavating Purgatory Cave and Cathedral Cave, and his discoveries are well known (Foote 1884b). Foote's emphasis on precision and accuracy in documentation is well evident throughout his writings, where he often criticized hasty excavations, and improper recording (Foote 1916a). He thus took great pride in his son's work; and when he revisited the caves in May to see how the exploration was proceeding, he was very gratified to find that, '...Mr. Henry Foote had organized his band of excavators very thoroughly, so that the work proceeded steadily and safely' (Foote 1884b: 208). He did not fail to put in a good word for his son, in the paper writing that, '..The efficient way in which he carried out the very arduous piece of work confided to him fully justified the confidence with which I had recommended him to His Excellency Mr Grant Duff, and will I trust be recognized by the authorities.' (Foote 1884b:208).

Henry Bruce Foote later married Jeanie Elizabeth Jessett[11]. Their first child's birth certificate registers her as Vera Violet Jeanie, born on 3rd March, 1899 at 10, The Mall, Dum Dum[12], and the record clearly indicates that Henry Bruce Foote, was Captain, R.A., Dum Dum. A son, Henry Robert Bowerman Foote, called 'Bob', was born in India on December 5th 1904, at Dum Dum, Bengal[13]. At the time of his birth, Henry Bruce Foote was stationed at Ishapore, Bengal. Major-General H.R.B. Foote, 'Bob' VC, was awarded the Victoria Cross in 1942, while a Commanding Officer of the 7th Royal Tank Regiment posted in the Western Desert Africa, for extreme bravery while facing Rommel's forces (Foote H.R.B. Obituary, 1993). After the death of his first wife, Henry Bruce Foote married Frances Grace Slator (1876-1955), on 26th April 1911, at All Souls Church, Langham Place, London. Henry Bruce Foote retired in 1919, and lived in the 1920's at Dinnard in Brittany, taking advantage of the favourable exchange rate. He returned to England and lived at Farnham Common, and died in 1932. Henry and Frances Foote had two children, Dr. John Bruce Foote (b. 1918, (M.A, M.D., F.R.C Path, ordained 1979); and Margaret Sybella, who also had a distinguished career in the field of education (Figs.8a,b,c).

'Two Red Earthenware Figurines' and Elizabeth Sophia Mary Foote

Robert Bruce and Elizabeth Ann's second child was a daughter, Elizabeth Sophia Mary (Lily), born on 28th December, 1865 at Little Bourne, Luz, Madras, and baptized on the 21st of January at St.Thome' (St.Thomas). During this period, Foote and his family were stationed in the Madras Presidency, while he was engaged in the completion of his important publication on tools found in lateritic formations in the Madras and South Arcot districts (Foote 1866). Elizabeth later married Herbert W. Leeming, a coffee planter, of Scotsforth Estate, Shevroy Hills, Yercaud, on 12th August,

Fig. 8a: Dr. John Bruce Foote and Mrs. Mary Foote

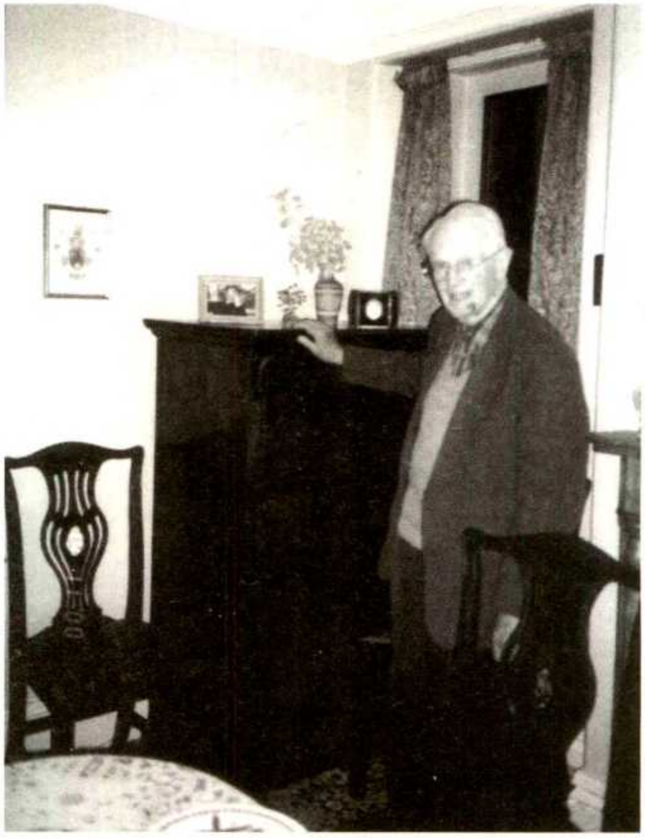


Fig. 8b: Dr. John B. Foote standing next to R.B. Foote's cabinet for storing antiquities and geological samples

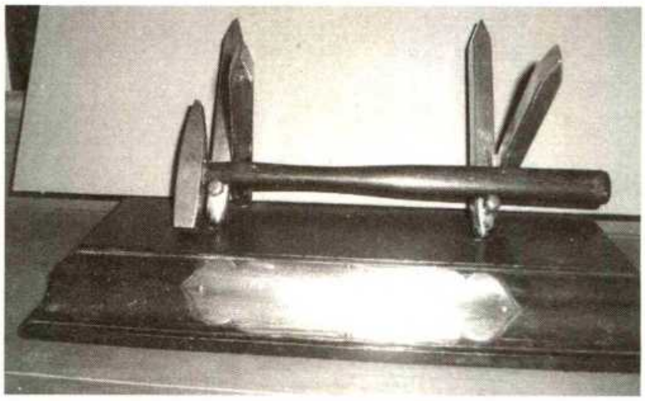


Fig. 8c: Photograph of a geological hammer presented to R.B. Foote with the inscription; 'This Effigy of the Most Ancient and the Most Recent Implement of the Geologist is Presented by the Officers of the Geological Survey of India to R. Bruce Foote Esq. F.G.S. the Most Senior and Distinguished Authority — On Both Aspects Of Indian Geology On The Completion of 50 Years Work In India', September, 27th, 1906 (Courtesy, Dr. J.B. Foote and Mrs. Mary Foote)

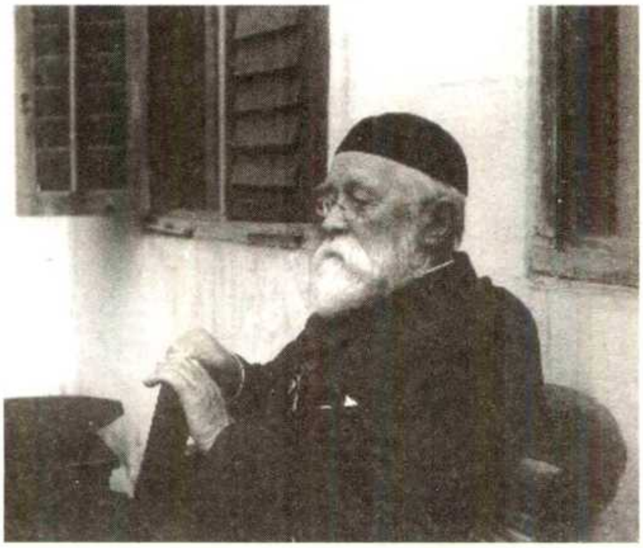


Fig. 11: Robert Bruce Foote in his later days

Fig. 12: inset: enlargement of fig. 12 showing R.B. Foote

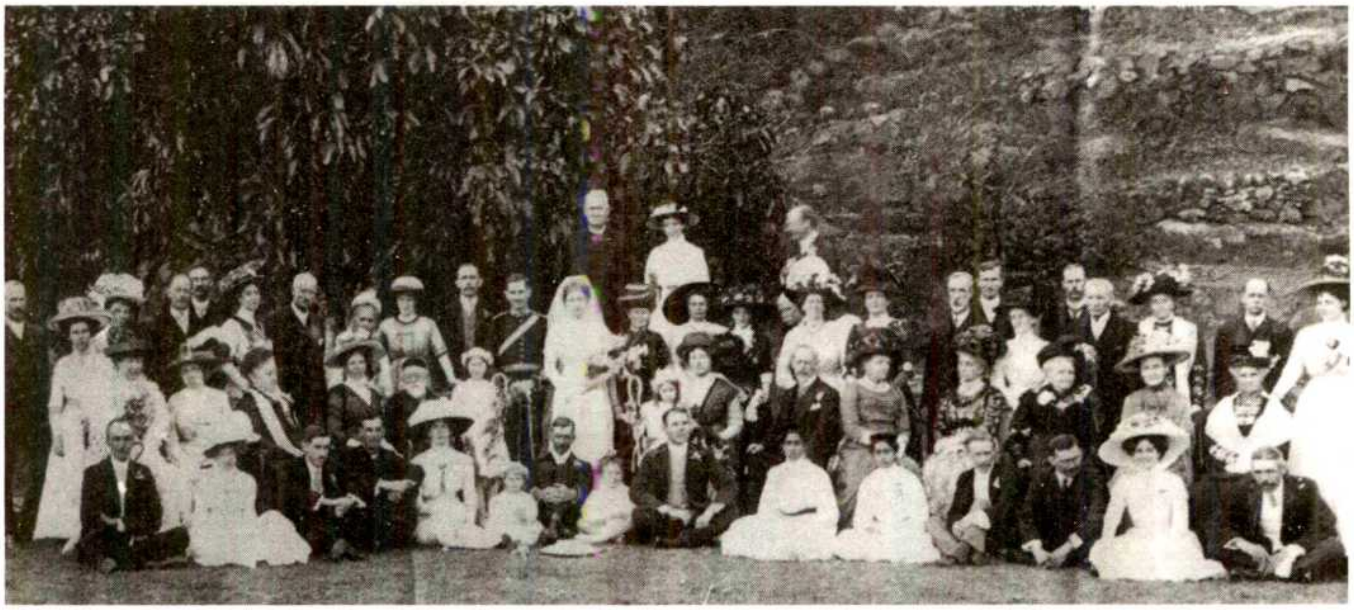


Fig. 12: A family gathering showing Robert Bruce Foote (middle row, seated, 5th from left, and Henry Bruce Foote, last row, standing, first from left), along with other family members, at the wedding of Foote's granddaughter, Iris, 'Binks' with Angus Urquhart. Foote's daughter Violet Anne can be seen standing to the right of the bride

1890. This was just a year before Foote's retirement from the Geological Survey of India. Writing in 1888, Fransesca H. Wilson (1888:42) noted that the view from Mr. R. Bruce Foote's house, in Yercaud, was very pretty, indicating that by this time, Foote had already acquired his home in the hills, following in the footsteps of his father-in-law, Revd. Percival.

It is of particular interest, that Foote specifically mentions discoveries made by Herbert W. Leeming of Scotsforth Estate, at Mulavi, (Salem district) and refers to him as being his son-in-law (Foote 1916a: 62, 1916b: 10). Leeming had discovered two red earthenware female figurines, while digging a trench for the foundation of a wall. They lacked legs, being on small cylindrical stands resembling 'little upright vases', they measured '5 3/8 inches', and were listed as antiquities nos. 1924*k* and 1924*l* figured in plates 21, 22 and 23. Although Foote found them '..very plain not to say ugly', he recognized their importance particularly owing to their unique headdress. They had hair dressed in short ringlets all around the head and wore high combs on top (Foote, 1916a: 62, 1916b: 10). He believed that these threw light upon neck rests (noted at the Iron Age site of Tiruma Kodlu Narsipur, Mysore), and inferred that they were possibly used by women to preserve their curls intact while sleeping. M.S. Hight, E. King Harman, F.D. Short, R.F. Carey, Thurston Short, and other planters

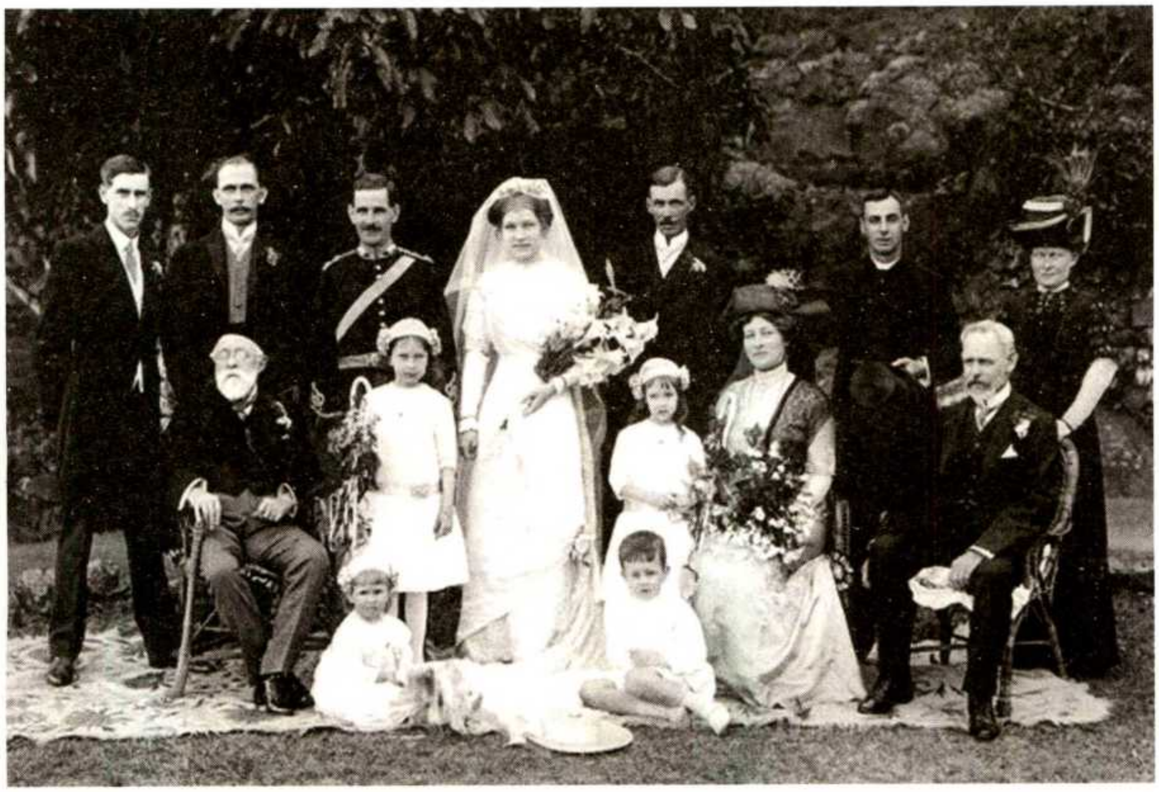


Fig. 13: R.B. Foote at a family function

and residents of the Shevroy Hills were inspired to search for sites and send antiquities to Foote, almost all of which were collected after 1890 (Foote, 1916a, b). It is thus possible that most of Foote's interesting documentation of antiquities of the Neolithic and Iron Age in Salem district, occurred after his daughter's marriage in this region and very possibly much after his retirement (Fig.11). This was despite the fact that he had surveyed the region earlier, at a time when he admitted that he was unable to recognize artefacts or sites (King and Foote 1864). After the death of H.W. Leeming, Elizabeth Sophia Mary married Walter Cherry, a tea planter from whom she had no issue.

International Congress of Prehistoric Archaeology and Vivian Percival Foote

Robert Bruce and Elizabeth Ann's second son, Vivian Percival was born on 30th November, 1867, at Charmwood, Streatham Common, Surrey and was baptized on 25th January, 1868. The International Congress of Prehistoric Archaeology, was held at Norwich, from 20-28th August, 1868. Foote's paper was in the Fifth Meeting on 25th August (Foote 1869). However, Foote was listed as being one of the four Secretaries of the Congress, and a Corresponding Member on the Committee of Organisation, representing India (International Congress of Prehistoric Archaeology 1869). It is unclear whether he was present at the time of this child's birth, but considering the importance of the Congress, it is very likely that Foote was in England at this time. His interactions with scholars and visits to view their antiquities are clearly mentioned (Foote 1916a:110), and it is clear that he spent a while in England. This child however, was to bring great unhappiness to the family. Vivian Percival was the black sheep of the family, and caused Foote and his family great despair. This is very clear from statements made in his Will, as seen later. Family sources say that Vivian was provided for a largely by his brother Henry Bruce Foote.

Chalcedony Flakes and Violet Anne Foote

The youngest child of Robert Bruce Foote and Elizabeth Ann, was Violet Anne (1870-1958) who was born in the bungalow of the great tank at Darojee (Daroji) in the Bellary district in 1870, and baptized by her grandfather on 5th May, when she was dangerously ill, and later at St. Thome' (St.Thomas). In one of Foote's research papers (Foote, 1873a), he discusses discoveries near Bellary, and it is possible that she was born during the course of his survey. Foote's memoirs on the geology of the south Maharatta country and adjacent districts (1876) was much later, but it is interesting to note that years later on 23rd April 1885, he mentions finding an oval palaeolith on the surface at Daroji (Foote 1916b:35). Violet Anne was only a few months old when her mother died, and as per family information, she was looked after by Revd. Peter Percival's family.

Violet Anne appears later in Foote's writings, and apparently shared his interest in the subject. We next hear of her, when he mentions antiquities collected by him in Baroda along with his daughter, Miss. V.A. Foote, on 19th February, 1892, from Vyara, Waghoria Taluk, near Baroda. This was evidently when Foote was appointed as the State Geologist of the princely state of Baroda in 1891, where he apparently shifted with his entire family. On this occasion, the antiquities collected by father and daughter (nos. 3049-3057), included Neolithic objects comprising a bulls head?, hammer, ball, cores and flakes, of chalcedony and agate, stoppers, lips of vessels, a cone phallus, and a slickstone or muller. She also found 'A curious little carved piece of hard green chlorite schist, No.3049……., bears a certain resemblance to the head of a hornless bullock..' (Foote 1916a:145, 1916b:196-197). He also states that Miss V.A. Foote collected, from the banks of the Gooma river, south-east of Sandasal (Baroda State), flakes of chalcedony, with glassy lustre, milky flakes, and agate cores (nos. 3059-3064). On the left or the south bank of the Gooma river in Sauli taluk, Miss. V.A. Foote found '..a very choice little chalcedony core..', milky with glassy texture (no. 3058), (Foote 1916a:145, 1916b:196-197). We next hear of her when she married Christian Gottlob/Gottlieb Lechler, also from an eminent family, and of the Brooklyn Estate, Shevroy Hills, on 26th January, 1893 at the Holy Trinity Church, Yercaud (Fig. 3). Violet's daughter's wedding brought together family and friends as seen in Figures 12 and 13.

Archaeology as a Family Passion: Eliza Mellisa Wells

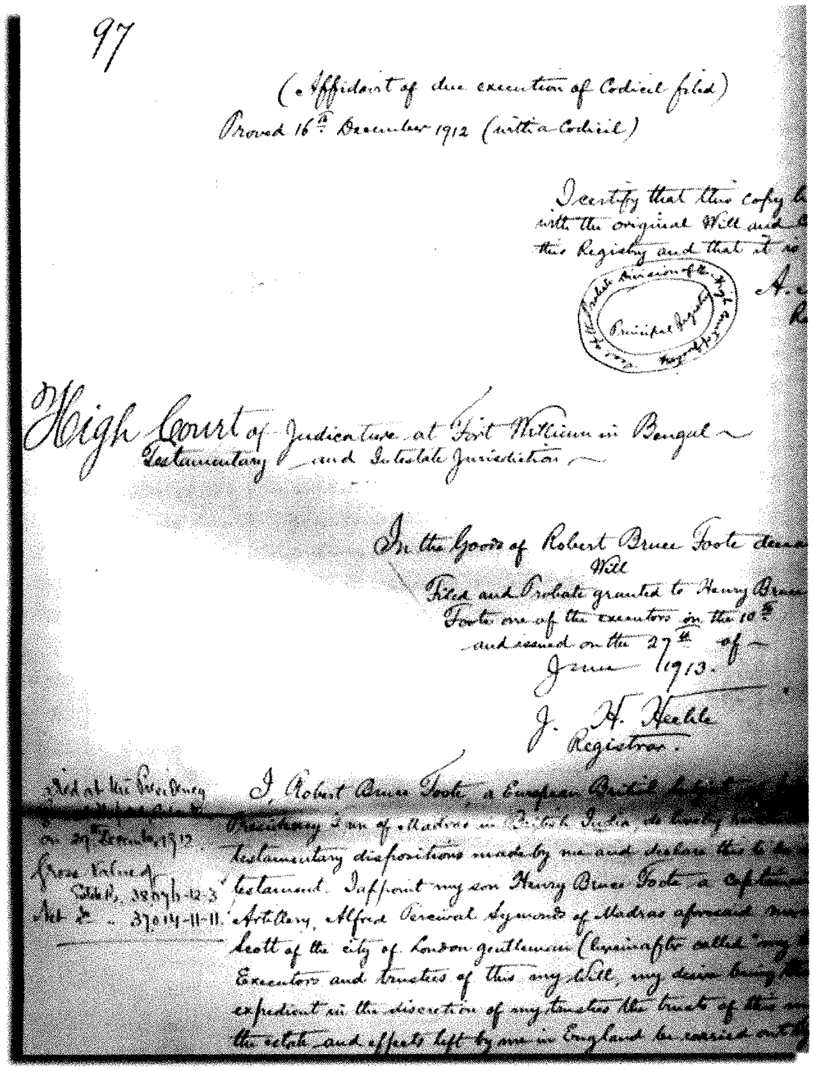
As mentioned earlier, Foote's first wife, Elizabeth Ann died in 1870. By 1873 he was busy completing his report on the geology of parts of Madras and North Arcot district (Foote 1873b). During the period 1872-1873, Foote was tremendously busy, getting ready for the Vienna Exhibition. He was in charge of the large collection of minerals and fossils to be displayed by the Geological Survey of India. Foote also exhibited some of his collections of South Indian stone implements, which were extremely well received. Prior to his return, on 22nd September, 1874, Foote married Eliza Melissa Wells, his first cousin on his mother's side, at Fittleworth, Sussex England[14] (Fig. 3). Eliza was the daughter of his mother's brother, Giffard Wells (see Fig. 2). This marriage lasted till his death, and Eliza Melissa's involvement in his work played an important role in his life. She moved to Little Bourne, Luz, Mylapore, Chennai. Not only did she look after the children from his first marriage, but also had four children of her own. Eliza's involvement in Foote's work is mentioned several times. During his explorations in Bellary, on the left bank of the river Tungabhadra, opposite the town of Hampasagar, he found, what he called, a neolithic burial place. It is in this exploration, that he mentions his wife, who along with him, searched very closely, for pieces of the 'elephant shaped funeral vase' (No. 2886/7) (Foote 1916a:185). The couple could not locate the missing animal's head '….though we devoted many hours to the hunt, a whole day and a long morning the next day..' (Foote 1916a:185).

Eliza Melissa and Robert Bruce's first child, Melissa Wells Foote is reported to have been born on 5th October, 1875, at Little Bourne, Luz, was baptized on 7th November, at St. Thome' (St.Thomas), but died and was buried on 1st November, 1876, and later re-interred at Yercaud, on 23rd November, 1877. Mary Agnes Bencraft Foote, was born on 11th March, 1877, once again at the family home at Little Bourne, Luz, but was baptized later at the Holy Trinity, Yercaud. By this time, we can assume that Revd. Percival had retired to Yercaud, and that under his influence the baptisms were carried out there. She married Charles Eccles Nixon Priestly (a Lt.Col. in the Indian Army and Acting Military Police, Burma). Constance Ruby Foote was born on 18th July 1878, and baptized on 13th September of the same year[15]. Records list the parents as Robert Bruce and Eliza Melissa Foote as being of Yercaud. James Sharp, was the officiating Chaplain. This was years before Foote retired to Yercaud, but we may presume that the family maintained a residence here. Constance Ruby later married William Markham Pritchard (a superintendent in the Kolar Gold Mines, 1881-1934). Pritchard features again in the list of individuals who contributed antiquities to Foote's collection. He is described as having found the spout of a red earthenware vessel with a button lip, on the surface of Wollagamadi Hill, Kolar Gold Field (Foote 1916b:31; antiquity no. 264*h*). It is significant to note that Foote's Will refers to his shares in the Mysore Gold Mines, very possibly owing to this relationship. By 1901, Pritchard is listed as the Chief Residential Officer, Kolar Gold Fields (www.geocities.com/atheus, 2960/kgf/1905.html). Helen Zóé Foote married Neville Harrison. Foote's youngest son, Giffard Wells Bruce (1885-1954) was a rubber planter in Ceylon and remained a bachelor (Fig. 3).

'..Prehistoric Antiquities or the Proceeds Thereof…': Last Will and Testatement

'I Robert Bruce Foote a European British subject at present residing in the Presidency Town of Madras in British India, ……declare this to be my last Will and testament' (Extract from the Will, 1899, codicil, 1908). Foote's last Will and testament[16] (Fig. 14). provide remarkable insights into his personality. Names and relationships are clearly defined, likes and dislikes are aired, and the varied nuances of family life are glimpsed at amidst the stilted legal language. A clear division of possessions and finances, including stocks and shares held, and debts and amounts to be recovered from various children and relations, all portray a practical man; - a man whose passion for the past did not translate into otherworldliness and vague abstraction.

A note in the margin on the first page of the Will, written in a hand different to that in the main text, informs us that he passed away at Presidency Hospital, Calcutta, on 29th December, 1912. In a letter written by Commonwealth Relations Office, London to Major General H.R.B. Foote, (his grandson), dated December 1962, (Ref. R. 2354/62),



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(Affidavit of due execution of Codicil filed)
Proved 16th December 1912 (with a Codicil)

I certify that this copy
with the original Will and
this Registry and that it

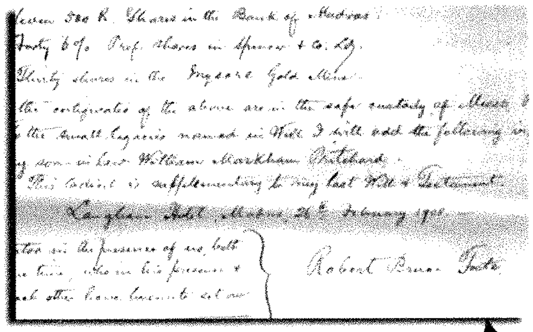
Principal

High Court of Judicature at Fort William in Bengal ~
Testamentary and Intestate Jurisdiction ~

In the Goods of Robert Bruce Foote
Will
Filed and Probate granted to Henry Bruce
Foote one of the executors on the 10th
and issued on the 27th of
June 1913.
J. H. Heckle
Registrar.

on 29th December 1912
Gross Value of
Estate Rs. 38076-12-3
Net do .. 37014-11-11.

I, Robert Bruce Foote, a European British
Presidency Town of Madras in British India do hereby
testamentary dispositions made by me and declare this to be
testament. I appoint my son Henry Bruce Foote a Captain
Artillery, Alfred Percival Symonds of Madras aforesaid
Scott of the city of London gentleman (hereinafter called "my
Executors and trustees of this my Will, my desire being
expedient in the discretion of my trustees the trusts of this
the estate and effects left by me in England be carried out by



500 R. Shares in the Bank of Madras
Forty 6% Pref. shares in Spencer & Co. Ld.
Thirty shares in the Mysore Gold Mine
the certificates of the above are in the safe custody of
the small legacies named in Will I will add the following
son in law William Markham Pritchard.
This codicil is supplementary to my last Will & Testament.
Langdon Hotel, Madras 26th February 1908
in the presence of us, both
who in his presence &
other have hereunto set our

Robert Bruce Foote

Fig. 14. Extracts from the last Will and codicil of R.B. Foote, (1st and last pages): showing his name and his signature

there is a handwritten note by the latter, stating that Robert Bruce Foote was cremated in Calcutta (Kolkata), on 3rd January, 1913. The Will was filed and probated by his son Henry Bruce Foote, (who was also one of the executors), on the 10th and issued on the 27th of June, 1913. This was done at the High Court of Judicature at Fort William, Bengal (Testamentary and Intestate Jurisdiction), by J.H. Heckle, Registrar.

The Will was however, drafted years earlier, on February 2nd, 1899, in the presence of T. Rowlandson, Solicitor, Madras; and J.S. Hendricks, Manager, Buckingham Hotel, Madras. A codicil to his last Will was drafted on 26th February, 1908, when stationed at Langdon Hotel, Madras. Here witnesses were Cecile Bertha Kidd, Spinster, Yercaud, Arthur Neville John Harrison, Assistant Examiner, Public Works Accounts, Madras. The affidavit of due execution of codicil filed, was proved on 16th December, 1912. These dates are important as they explain many statements in the Will, as discussed below which would otherwise remain puzzling.

His son Henry Bruce Foote, at that time a Captain in the Royal Regiment of Artillery, was one of the executors. The two other trustees and executors were Alfred Percival Symonds, listed as a Madras merchant, and Howard Scott of the city of London, listed as 'gentleman'. It is evident that Foote left behind property in England as well, 'estates and effects', which were to be dealt with by the trustee or trustees resident in England. His effects and estates in British India were to be handled by the trustee/s resident in the country at the time of execution. A note in the margin of the Will states that at the time of his death, the gross value of his estate was Rs.38076-12-3 (i.e. in rupees, annas and pice), and the net value being Rs. 37014-11-11. Foote was thus a wealthy man at the time of his death.

In addition to the trustees, he writes, '....And I appoint my dear wife Eliza Melissa Foote during her life and after her death my trustees to be the guardian and guardians of my infant children'. At the time of drafting the Will, his youngest son, Giffard (b.1885) would have been only around 14 years, whereas at the time of Foote's death, the children were no longer infants. Foote left everything to his wife, with one notable exception.

In the Will of 1899, it is significant that in the distribution of his property he specifically left out, '...my collection of Indian Prehistoric Antiquities or the proceeds thereof which shall form part of my general estate..'. Very clearly, he had definite plans on the future of these antiquities. Here, it is significant to note that as early as 1868, in the course of the International Congress of Prehistoric Archaeology at Norwich, the Swedish archaeologist, Prof. Nilsson, was said to have greatly admired and desired to purchase artefacts No. 2204-9; an offer turned down by Foote. However, in the same year, Foote allowed the greater part of his early collection of tools to be distributed by John Evans, to Charles Lyell, John Lubbock, Colonel Lane-Fox (Pitt-Rivers), C. Wickham Flower, and James Wyatt (Foote 1916a:109-110). Later his collections also found their way to the Blackmore Musuem amongst many others (Stevens 1870).

In 1873, during the International Exhibition in Vienna he received many offers to purchase some of these antiquities from Prof. Hochstetter, and other German scholars, but refused on the grounds that he wished these to remain in India. These were later presented to the museum of the Geological Survey of India, and then transferred to the Indian Museum, Kolkata. After Wood-Mason's time, however, these collections were much neglected (Foote 1916a:110), and it was only when Foote officiated as Director of the Geological Survey in 1887, that he had a chance to recover and exchange some of the old 'Vienna' specimens in return for more recently collected antiquities. When the codicil to the Will was drafted in 1908, Foote had already sold his collections to the Madras Museum. This was done in 1904 for a sum of Rs.33,000 (Devasahayam 2004:111) when Edgar Thurston was Superintendent (Centenary Souvenir 1951:35).

With this exception he left everything to his wife, '.....all my plate, linen, china, glass, books, pictures, prints, wines, liquor, furniture, and other household effects and all my carriages and horses'. He also left her the sum of two hundred pounds to be paid within one calendar month of his decease. His share in the Army and Navy Co-operative Society of London (share no. 54661) was also bequeathed to her.

In addition to his wife, the Will specifies individual legacies to various family members. Here he enumerates sums to be paid to his daughters, Mary Agnes Bencraft Priestly, Constance Ruby Foote and Helen Zóé Foote, his daughter-in-law Jeanie Elizabeth (wife of Henry Bruce Foote), and to each of his sons-in-law, as well as to his executors. The deep affection for his first born, Henry Bruce Foote, is clearly evident. Foote left Henry Bruce his '...silver half hunting watch by George Moore No.13177 in remembrance of my dear brother Hal'. He also left him his gold pencil case, and an old cable link watch guard, which were obviously prized possessions. Similarly, his youngest son Giffard Wells Bruce Foote, was left, '....the gold locket his mother gave me on our engagement, also my bloodstone signet ring, also my red carnelian intaglio ring left me by my aunt Henrietta Rogers, also my dear fathers' old dressing case and its contents and also my gun'. Other personal belongings including his first wife's wedding ring, gold and agate shirt studs, gold and blue enamel shirt studs, and gold wrist links, were bequeathed to his daughters from both wives.

The Will also contains detailed instructions to his trustees on matters related to the management of his finances and estates, instructions to pay for the funeral and other debts, and managements of legacies specified. As regards financial bequests, Foote specified that the children of his first wife, Elizabeth Ann Foote, i.e. Henry Bruce, Lizzie Sophia Mary Leeming, Vivian Percival and Violet Annie Lechler, were to be paid the sum of Rs. 20,000 (equally divided amongst them) and which represented the money which came to him, as a result of his marriage to their mother. For Vivian, he specifies that this was to be the '..only provision I feel it incumbent upon me to make for him by this my will', reasons for which are made clear later on. An interesting note concerns details related to an insurance taken on Madras Equitable Assurance Society on the life of his brother-in-law, William Alfred Symonds, clearly indicating that the latter was at some point in time in debt to Foote. Details on amounts to be paid to his second wife', Eliza Melissa during her lifetime were laid out, as also instructions on the status, rents and eventuality of sale of his house in Yercaud, Ivy Cottage (Fig. 15). Permission was also granted to his trustees, to invest money in stock funds or securities as per existing laws of the time.

In a codicil drawn up on 26th February, 1908, when at Langham Hotel, Madras, he again emphasized the nature of the division of the legacy of Rs. 20,000 which came to his first wife, Elizabeth Anne Foote, from her uncle Daniel Percival. This is confirmed in the Wills of both Revd. Peter Percival and that of his brother Daniel (courtesy, F.Ashton). Foote specified that this legacy was to be divided equally amongst Elizabeth Ann's four children, after debiting the loans they had taken from him. An interesting account is given, of the exact amounts loaned to his children along with details of the debts they had repaid till date, and the balance due. He also specified the division of funds in the event of a sale of his house, Ivy Cottage. Once again one notes the despair and anger at his son Vivian's behaviour, '..whose systematic misconduct for many years has caused him to forfeit all feelings of goodwill on my part'. Shares alluded to in the Will as being held by Foote, included those in Messr. Parry and Co. Madras, debentures in the Deccan Sugar and Abkari Company; shares in the Bank of Madras; shares in Spencer and Co., Ltd., and in the Mysore Gold mine.

The Will is a powerful testimony to the many hidden facets of Foote's personality. His skill in finances and careful track of investments, shares and debentures; methodical recording of loans taken by his children, interest rates, and the like, testify to a man with a shrewd sense of business. His

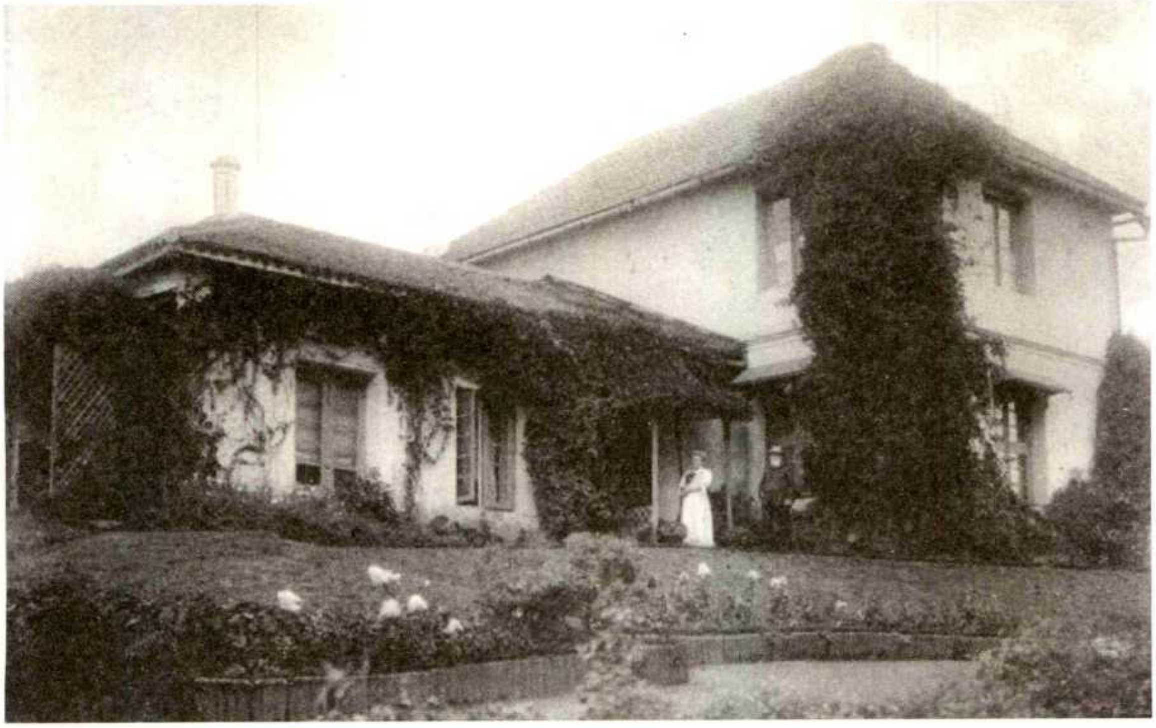


Fig. 15: Ivy Cottage, Yercaud, showing R.B. Foote near the entrance

anticipation of the sale of antiquities is clear in the main text of the Will, even though the actual sale was only later. The hardships of a life in the field (Foote, 1882), stand out in striking contrast to his mention of a house, evidently situated in a scenic locality (Wilson 1888:42), stocked with fine wine, furniture, linen, carriages, horses, and guns. His disgust for the trouble caused by his second son Vivian, and deep affection for first born Henry Bruce and last born Giffard are clear, as also his attempt to divide various legacies in a fair and just manner between all his children, keeping in mind promises made to his father-in-law Revd. Percival.

During the period ranging from drafting his last Will in 1899, codicil in 1908, and death in 1912, Foote was busy completing his monumental catalogue for the Madras Museum (Foote 1916a,b). As noted by others (Centenary Souvenir 1951; Paddayya 2007), the first version of this appeared in 1901. A journal in possession of the author, (SCHE/RBF/02) (Fig. 16), provides the first rough notes of chapters which were to appear in the final volumes published later. Although this is not the subject of this paper, it may be briefly mentioned, that it here that Foote listed ideas, observations, references to other articles, as also rough drafts and illustrations which were to take their final form in the completed volumes.

Family versus 'The Weariness of a Solitary Life'

Robert Bruce Foote joined the Geological Survey of India, only a few years after its foundation, at a time when amongst other pressures, geologists were expected to rise above field surveys and conduct research as well (Sangwan 1993). As Foote rightly observed, this was practically extremely difficult, as the geologist being for the most part in remote areas, '….cannot enjoy the luxury of a library, although he may constantly need to refer to his books with reference to his current work' (Foote 1882: 326). In these difficult conditions the mortality of geologists was still quite high (Foote 1882:327), and they were subjected to the dangers of the climate, disease and wild beasts. In this context, Foote had the ability to balance the pressures of mapping, documentation for 'economic geology', and the need to produce 'scientific' results and research. After morning rounds from '…fifteen to twenty-five miles, partly performed on foot under exposure to the sun for from six to eight hours…', (Foote 1882:326), he spent the afternoon mapping and writing up the day's work, and in his rare spare time, kept himself informed on the progress of science. Moreover, these skills were also applied in the mapping, documentation and research of pre-and protohistoric sites. In the history of colonial geology or archaeology, Foote stands out as a man who was keen to aim for the highest standards of perfection, although often frustrated at being so distant from the centre of exciting developments in England and Europe (Foote 1882, 1916a).

In addition to his scholarship, Foote stands out as a family man: whose family was supportive and involved in his passion for studying India's past. His wives, children and an extended network of family and friends helped him in his passion for research, documentation and collection of antiquities. As a young man, Foote was influenced by his father-in-law, Revd. Peter Percival, whose scholarship in the field of Tamil and

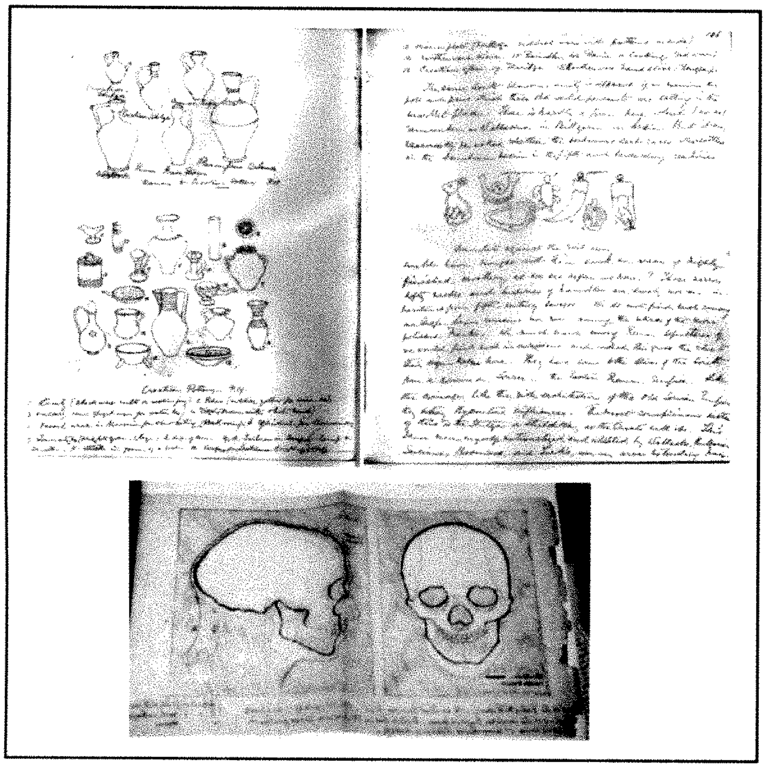


Fig. 16: Pages from the journal of R.B. Foote

Telugu studies, and other aspects of Indian culture; placed Foote within a circle of intellectuals interested in the study of India's past. The untimely death of his first wife, Elizabeth Ann, leaving behind infant children, is never mentioned directly; although the depth of this relationship is clearly seen in the long and sustained contact he had with his father-in-law Revd. P. Percival. Of all his children, Foote placed great trust and faith in his eldest son, Henry Bruce, as is seen in his decision to nominate him as being a suitable candidate to conduct excavations at the Billa Surgam complex. This also reflects the immense respect and trust which Grant Duff, the Governor of Madras, placed in this decision, very possibly overriding other more qualified scholars involved in archaeological studies. Further, marriage alliances entered into by his daughters, led to the widening of a network of individuals who were to contribute antiquities and information on sites. This is seen clearly in the case of discoveries made in the Shevroy Hills of Tamil Nadu, and in Mysore. Foote's first wife, Elizabeth Ann illustrated stone tools, published in Foote's seminal paper of 1866. These were referred by contemporary scholars as proof of the antiquity of humanity in India. They still remain important as a source of information on tool types discovered by Foote. His second wife, Eliza Melissa, was evidently present at several occasions during his field surveys and knew enough to discover important antiquities. His daughter Violet Anne, collected artefacts in the Baroda State, displaying a knowledge ranging from chalcedony flakes to Neolithic tools. Despite the unhappiness caused by his son Vivian, we see Foote as a man surrounded by the love and affection of his family members, who did their best to contribute in their own small way towards building up a picture of India's past. Foote's family, may thus be viewed within the context of his untiring quest for understanding processes underlying India's geological and archaeological past.

Despite the family's involvement in his work, it is evident that much of his life was spent alone. As late as 1882, he mentions the extreme loneliness which formed a part of his job as a geologist (Foote 1882). Although a large part of his work was done along with William King, Foote writes, '...Then too is the weariness of a solitary life in outlandish places where a white face is sometimes not met with for months together' (Foote 1882:325). Foote states that the '...severance, though temporary from civilization, means separation from wife, family, and friends.' (Foote 1882:326).

This abridged genealogical study drawn from data in possession of the author, while exciting by itself, serves several purposes. It fills in large gaps in our knowledge of Foote's family history, provides glimpses into his personal life, and the importance which family links and networks had in his work. It may be fair to say that Foote's contributions in various fields of scholarship, his collection of antiquities and discoveries, owe as much to his family and friends, as to own his initiative and diligence. In the study of any great personality, such as Robert Bruce Foote, there is a subtle interplay between personal and professional spheres of life, and it is in understanding this complexity, that one can achieve a true biographical study of this fascinating personality.

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I am very grateful to Mr. Srikanth Pradhan who aided greatly in processing some of the valuable images seen here. I thank my husband Abhijit Ghosh for critically reading and commenting on this paper. My colleague, Dr. Kumar Akhilesh has been untiring, (despite the pressures of studying collections from Attirampakkam), in cataloging the data, and in inputs as regards this paper. Archival sources and libraries in India and England were consulted for this research, including amongst others, the Oriental and India Office Collection of the British Library, State Archives, Tamil Nadu, Cambridge University library, Geological Survey of India, and Deccan College Postgraduate and Research Institute.

Notes

1. Certificate of Fellowship of the Geological Society, London, Courtesy, Geological Society, London.
2. Correspondence between 'Hal' (Major-General Henry Robert Bowerman Foote) to Vera Violet Jeanie dated 18th June, 1964, Church Cottage, Sidlesham Susse, Sidlesham 231 (unpublished letter).
3. The National Archives, Public Record Office, Catalogue Reference:Prob 11/1853. Image Reference: 415.
4. Letter from College of Arms, Queen Victoria Street, London, E.C.4, (J.R.B.Walker, M.V.O., M.C.), dated 1st September, 1863, to Miss. Foote.
5. Record No. 4987. Registry of Births, Dr. Williams Library, London. (courtesy, Mrs. Florence Ashton).
6. San Thome' Marriage Vol. 43, Folio 198.
7. Will of Revd. Peter Percival. Courtesy, Mrs. Florence Ashton.
8. Madras BMD 1878 &1879 Film # 0521866 Vol. 59 1878, and LDS Film #0521867 Vol. 60 - 1879.
9. San Thome': Marriage Vol. 43, Folio 118.
10. St. Thome' (St.Thomas)' Birth Records: Vol. 44, Folio 99.
11. Jeannie Elizabeth was the eldest daughter of Frederick Bowerman Jessett, FRCS, England and Fanny E.O. at St. Peters, Eaton Square on 22nd February 1893. They were married by Rev. Thomas Hardy, Vicar of Firth, assisted by Revd. J. Armitage, Army Chaplain.
12. Certified Copy of an entry in an Army Register Book of Births deposited in the General Register Office, Somerset House, London, App. No. S.R. 53654/30 and Baptisms. Vol. 74, Fol. 79. Bengal; Secretary of state for India Register of Baptisms at Dum Dum, 1899.
13. Major-General H.R.B. Foote, 'Bob' VC, went on to become a well known name in England, even being featured in the popular Television Serial 'This is Your Life', owing to his distinguished career. In 1942, he was Commanding Officer of the 7th Royal Tank Regiment posted in the Western Desert Africa, facing Rommel's forces. His extreme bravery in the course of this famous battle, earned him the Victoria Cross (Obituary, Daily Telegraph, 25th November 1993) in 1942, and this reads, '...His name was a byword for bravery and leadership throughout the brigade'. He held various posts including Director-General of Fighting Vehicles at the Ministry of Supply, Director of the Royal Armoured Corps at the War Office. After retirement he was military advisor to Leyland. He was awarded the DSO in 1942 and appointed CB in 1952, and was also chairman of the Tank Museum at Bovington. He married Anita Flint Howard on December 28th 1944, at the Church of St. Thomas-on-the Bourne, Farham. He is listed as the son of the late Lieutenant-Colonel, H.B. Foote, R.A, and Mrs. Foote, while his wife is noted as the daughter of the late Carey Howard and Mrs. Howard of California, USA (The Times, Monday, Jan 01, 1945, pg.7, Issue 50029, col. B. (The Times, Digital Archive, 1785-1985). Anita Flint Howard died in 1970, and he married Mrs. Audrey Mary Ashwell in 1981. He died on 22nd November, of bronchopneumonia and a stroke, 1993, at Southlands Hospital, Shoreham by Sea. They had no children. (Certified Copy COL529465), General Register Office
14. Oriental and India Office Library. Batch: MO70501 Dates: 1559-1875, Source: 416757, Call No. 918252, Type:Film.
15. Madras BMD 1878 & 1879 Film # 0521866;Vol.59 1878, and LDS Film #0521867 Vol. 60 – 1879.
16. Will of Robert Bruce Foote. Affidavit of Due Execution of Codicil Filed, proved on 16th December 1912, Issued on 27th June, 1913.

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Archaeozoological Evidence from the Ghaggar Valley with Special Reference to Tarkhanewala Dera and Chak 86, District Ganganagar, Rajasthan

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Abstract

Since the early twentieth century, explorations in the dried bed of the River Ghaggar in the northern part of Rajasthan have indicated the rich archaeological potential of the region. From the Ganganagar District in particular, numerous sites belonging to the Harappan, Painted Grey Ware and Historic period were reported by A. Ghosh in the nineteen fifties. In spite of the rich archaeological evidence very few faunal studies have been attempted so far excepting that at Kalibangan. Hence, till date information regarding animal exploitation patterns during the Harappan and later periods from this particular region, is virtually unknown. It is on this background that the faunal evidence unearthed from the recent 2003-2004 excavations at Tarkhanewala Dera and at Chak 86 is significant. This paper presents results of the analysis carried out on faunal material from these sites.

Introduction

Since the early twentieth century explorations carried out in the territories drained by the Ghaggar-Hakra rivers, has highlighted the rich archaeological potential of the region. This river also commonly referred to in ancient texts as the 'Sarasvati', today has a dry bed having a width of 4-10 km which can be traced from the Siwalik Hills to the Rann of Kachchh. Its course lies between the Sutlej and the Yamuna passing through the states of Punjab, Haryana and the Bikaner district of Rajasthan. It then enters the Bahawalpur state in Pakistan where it is referred to as the Hakra. Due to its complex hydrology, past hydrographic changes that the river has undergone has been debated upon for some time. Both archaeological and hydrological research has shown that around 2000 B.C. it was a large perennial river flowing independently along the fringes of the Thar Desert and finally debauching into the Rann of Kachchh. However, it dried up due to the shifting of the Drishadvati (Yamuna) and Sutlej, but was revived for brief periods of a few centuries during the terminal second millennium-early first millennium B.C. Again during the early centuries of the Christian era probably because a part of the Yamuna water was again received (Misra 2007)

In the early 1940's Sir Auriel Stein found numerous settlements in the Bikaner district of Rajasthan and Bahawalpur in Pakistan (Stein 1942). Between 1950 and 1953, explorations carried out by A. Ghosh in the Ganganagar District of Rajasthan revealed the presence of more than one hundred sites along the dried river channels of the Ghaggar. These were classified by him as belonging to the Harappan, Painted Grey Ware and Historic cultures (Ghosh 1953). Since then a little over 500 sites belonging to all phases of the Harappan civilization are today known from the Ghaggar valley in Punjab and Haryana, besides Rajasthan (Misra 2007). Some important excavated sites are Kalibangan, Balu, Siswal, Banawali, Mitathal, Kunal, Rakhigarhi, etc. Apart from Harappan sites those belonging to the Painted Grey ware (PGW) and Rang Mahal culture have also been recorded. All these investigations have helped document a rich archaeological sequence from the Early Harappan to the Historical period in the Ghaggar Valley. The presence of a large number of Harappan affiliated sites in this region has made it a very crucial area for understanding the early development and growth of the Harappan civilisation as well as of the succeeding cultures.

In recent years, considerable archaeozoological research regarding Harappan subsistence has been carried out at sites in Gujarat (Thomas 2002). Some limited studies are also available for sites located in Haryana and parts of Rajasthan. In the Ghaggar Valley in spite of the rich archaeological data, animal bones have largely remained ignored. It is only at Kalibangan that animal bones were studied by Nath (1969) and Banerjee *et al.* (2003). Even though this site was excavated for nine seasons and animal bones were recovered in large quantity, no detailed faunal research was carried out. At this site besides domestic animals like cattle, the presence of wild animals such as barasingha (*Cervus duvacelli*), barking deer (*Muntiacus muntjack*), wild pig (*Sus scrofa*), etc. was identified (Banerjee *et al.* 2003).

Due to the limited faunal studies it is difficult to trace the nature of animal exploitation patterns during the Harappan and later periods in this region. Hence faunal

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evidence unearthed from the recent (2003-2004) excavations at Tarkhanewala Dera and at Chak. 86 is significant. In this paper, results of the analysis carried out on the faunal material from both these sites is presented.

The two ancient sites at Tarkhanewala Dera (29° 15'N; 73° 14' E and Chak 86 (29° 15' N; 73° 14' E) are individual mounds located close to each other in the dry bed of river Ghaggar in Anupgarh tehsil, district Ganganagar, Rajasthan (Fig. 1). These are centrally protected sites which are situated at a distance of about 6 km north of Anupgarh on the state highway no: 3 leading to Ganganagar. Both the sites were first excavated by A. Ghosh (1953) of the Archaeological Survey of India in the 1950's during his explorations in the region. He observed that they were close to each other and separated by a canal and a road, which made continuous excavations impossible. Excavations carried out by him revealed the remains of a Mature Harappan site at Tarkhanewala Dera and of Painted Grey Ware culture at Chak 86. He was of the opinion that both cultures were independent of each other and did not have any contact. No faunal remains were reported from these sites.

In 2003-2004, Tarkhanewala Dera and Chak 86 were once again excavated by the second author and his colleagues on behalf of the Archaeological Survey of India (Trivedi and Patnaik 2003-2004). These sites face destruction caused by cultivation, brick making, etc. At Tarkhanewala Dera, as many as ten trenches were taken up for excavation (A1, B1, C1, XA1, XB1, XC1,YA1, YB1,YCI). The excavation yielded residential structures with mud bricks, terracotta sealings, beads, animal and human figurines, bangles, objects of stone, copper and bone along with typical Harappan ceramics From the archaeological evidence unearthed it was found to be a single culture site of Mature Harappan affiliation (Trivedi and Patnaik 2003-2004).

The ancient mound at Chak 86 lies close to the modern village G.B.87 and is spread over an area of 5.5 ha. Three trenches (A1, A2 and A3) were excavated on the top of the mound which is 3.5 m above the surrounding plains. The excavation yielded six circular plans representing huts, of which only two could be identified. Their diameter varies from 1.80 to 2.20 m. Within the hut perimeter traces of post holes and burnt potsherds were found. Below the circular huts, 4 to 5 mud bricks placed horizontally in an alignment were noted. The antiquities characteristic of the Painted Grey Ware culture such as ceramics, terracotta objects, beads, objects of bone, shell and stone were recovered (Trivedi and Patnaik 2003-2004). The excavations indicated that Chak 86 was a single culture site belonging to the Painted Grey ware culture. The findings from both these recent excavations were similar to those earlier reported by Ghosh (1953).

Animal bones in appreciable quantities were recovered from both sites. These were sent to the Archaeozoology Laboratory at the Deccan College, Pune, where a detailed study was carried out by the first author. All bone fragments were recorded, weighed and identified following

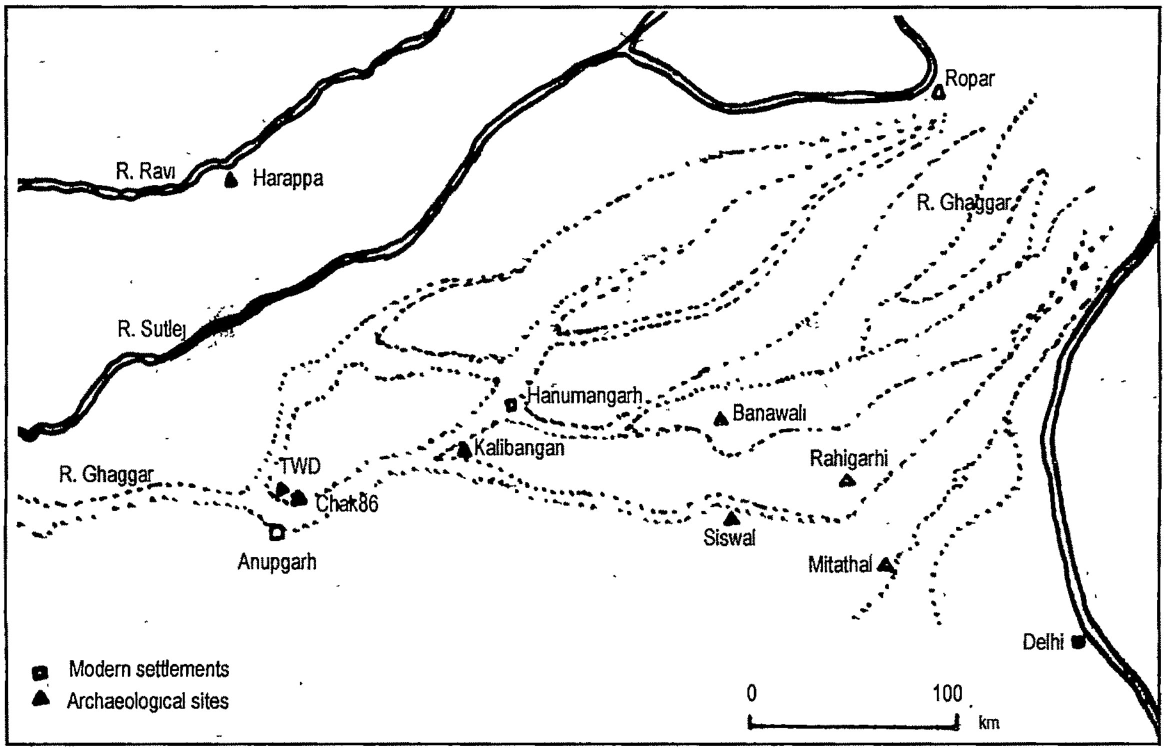

Fig. 1: Location of Tarkhanewala Dera and Chak 86 in Ganaganagar District, Rajasthan

standard procedures of faunal analysis. Each bone fragment was examined for cutting and chopping marks, modifications, chemical alteration, weathering, burning activity, discolouration, etc. Dimensional measurements were taken of all measurable bones. Bone identification was attempted to the species level by comparison with the reference skeletal collection of modern animals housed in the archaeozoology laboratory. The Schimdt's Atlas of Animal bones (Schimdt 1972) was also consulted while carrying out the species identification. The majority of bones at both sites are in highly fragmented state, yet show fairly good preservation and could be identified.

Fauna from Tarkhanewala Dera

A total of 94 animal bone fragments were studied. Bone samples from only the following trenches XA1, YC1, XD1, B1 were available for a detailed study (Table 1). Bone measurements were taken on metacarpal, metatarsal, phalanges and astragalus (Table 4, 6 and 7). Only five bones in the assemblage showed traces of charring.

Table 1: Context of bone samples studied from Tarkhanewala Dera

Trench	Stratum	Depth (cm)
XD1Qd 4	1	4-9
XA1Qd3	1	10
XD1Qd4	2	16-18
YC1Qd3	1	17-19
XA1/2	1	23
XA1Qd2	2	23-30
XA1Qd3	3	38-42
B1Qd3	2	41-46
B1Qd1	4	50-53

The following animal species were identified at Tarkhanewala Dera (Table 3): mammals (6), birds (0), reptile (1), fish (1) (Deshpande-Mukherjee in press). In the collection very few wild animals were found.

The entire collection is dominated by the bones of domestic cattle (*Bos indicus).* Some of the cattle bones because of their fragmentary nature and absence of skeletal markers could not be identified specifically as of cow or buffalo. Hence, these are collectively grouped under *Bos/ Bubalus*. Almost all body parts like humerus, femur, metapodials, vertebrae, ribs, astragalus, are represented. (Fig. 2) However a limited representation of teeth in the bone assemblage was observed. Some bones have traces of charring and cut marks on them suggesting butchering and meat processing activity associated with dietary use. One bifid thoracic spine was found in locus XA1/2, stratum 1,

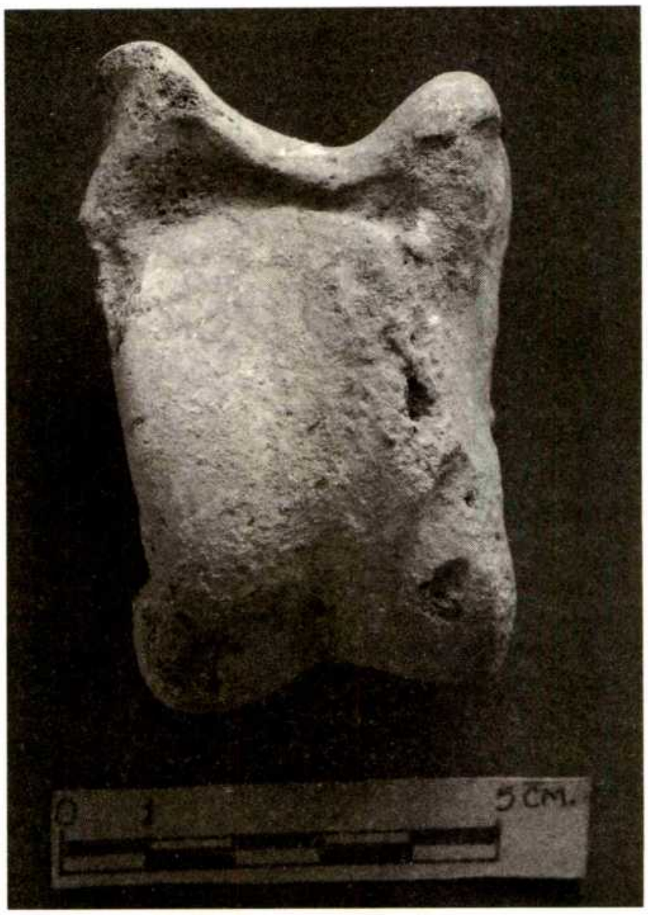

Fig. 2: A complete astragalus of *Bos indicus* from Tarkhanewala Dera

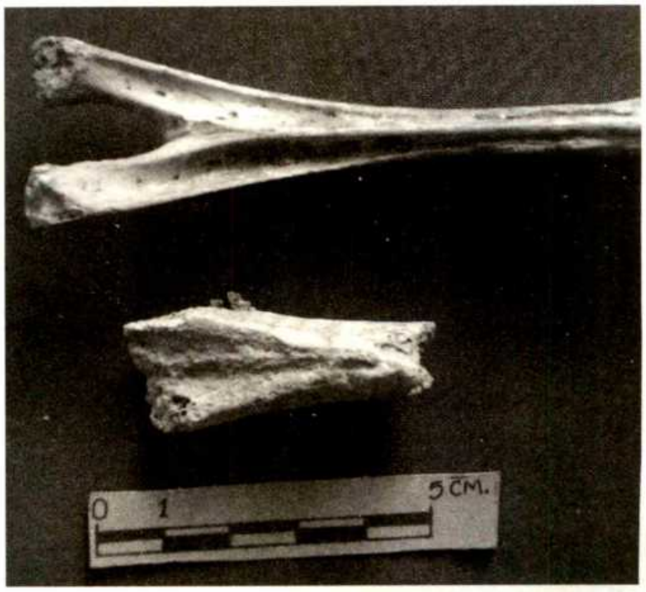

Fig. 3: Bifid spine of thoracic vertebrae of *Bos indicus* from Tarkhanewala Dera

Table 2: Context of the Bone samples at Chak 86

Locus	Stratum	Depth (cm)
A1Qd1	2	42-52
A1Qd1	4	37-50
A1Qd1	4	35-51
A1Qd1	4	51-60
A1Qd1	4	1.22-1.35
A1Qd3	1	36-38
ZA1Qd1	2	10-44
ZA1Qd2	2	33-40
ZA1Qd3	2	30-50
ZA1Qd3	2	50-56

at a depth of 23 cm (Fig. 3). This characteristic skeletal feature is found only in the humped cattle Zebu (*Bos indicus*). It was possible to calculate the height at withers for *Bos indicus* using the medial length of a complete astragalus (Table 7) (Zalkin 1970; Joglekar 1991; 2000-2001) which was 120.01 cm.

A few bones fall in the size range of sheep, goat and deer, but these due to their fragmented nature could not also be separated species-wise. Hence, these were collectively grouped as small ruminants. Among these some could be further grouped under sheep/goat category and comprised bones from the femur, metacarpal, metatarsal, axis vertebrae, phalanx and ribs. The presence of bones of a young goat with cut marks indicates its dietary use. The domestic sheep (*Ovis aries*) is represented by the distal portion of a metacarpal with a fused trochlea in locus B1Qd.1, stratum 4 at a depth of 50-53 cm (Fig. 4).

Among wild fauna, a general absence of both herbivores like deer, antelopes and carnivores along with smaller mammals is observed. The reptiles are represented by two shell fragments of turtle species (*Trionyx gangeticus)* (Fig. 5 and 6). One carapace fragment was found in locus XA1Qd. 3, stratum 3 at a depth of 38-42 cm. While a fragment of a plastron from the turtle shell was found in locus YC1Qd.3, stratum 1 at a depth of 17-19 cm. Their presence indicates the additional exploitation of aquatic animal resources for food purposes at the site. The occurrence of a fish spine in locus XD1Qd. 4, stratum 2, depth 16-18 cm. provides further evidence for this.

Fauna at Chak 86

A total of 65 animal bones were studied from the following context (Tables 2-3)

Measurements were possible in case of bones like the astragalus, teeth, first and second phalanges and calcaneum. (Tables 5-7). A few bones showed traces of charring (7). The entire assemblage is dominated by bones of domestic cattle (*Bos indicus*) (Fig. 7) (Deshpande-Mukherjee in press). These are represented by fragments of the vertebrae, long bones, teeth, astragalus and phalanges. All these show traces of butchering activity for food consumption in the form of charring and cut marks. For *Bos indicus* the height at withers was calculated using the medial length of astragalus (Table 7), (Zalkin 1970; Joglekar 1991; 2000-2001). The mean cattle height at the withers was 112.13±4.23 (maximum 119.40 cm, minimum 104.95 cm). The domestic goat *Capra hircus* is represented by a few teeth, ribs, vertebrae, calcaneum and long bones (Fig. 8). The fragmented condition of these bones also suggests the use of sheep/ goat in the food economy. The

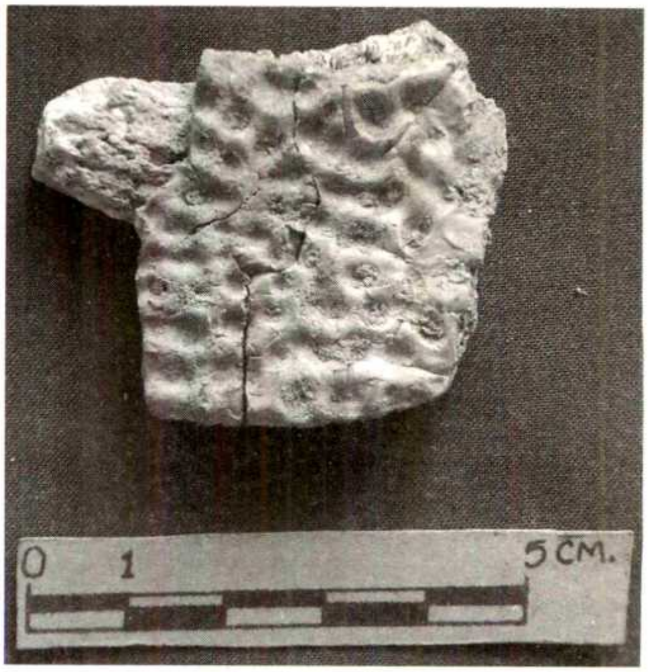

Fig. 6: Carapace of *(Trionyx gangeticus)* from Tarkhanewala Dera

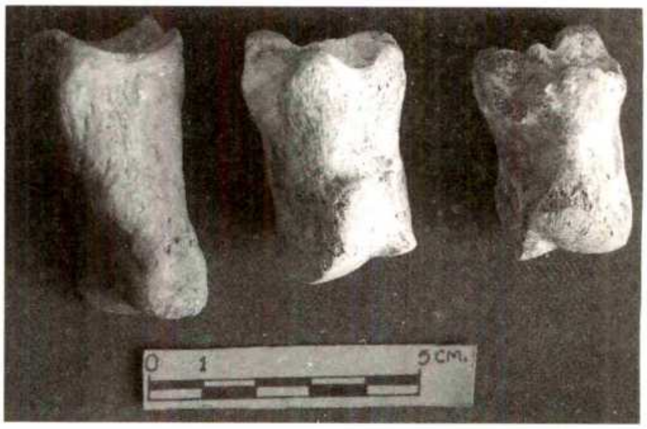

Fig. 7: First and second phalanges of *Bos indicus* with charring marks from Chak 86

Table 3: Animals identified at Tarkhanewala Dera (TWD) and Chak 86

Species	TWD	Chak 86
Bos indicus (domestic cow/ox)	26	14
Bos/Bubalus (domestic cow/ox/buffalo)	9	24
Equus assinus	-	1
Capra hircus (goat)	4	3
Capra/Ovis (goat/sheep)	9	-
Ovis aries (sheep)	1	-
Small ruminant	1	1
Trionyx gangeticus (Turtle)	2	-
Fish species unidentified	1	-
Unidentified bone fragments	41	22
Total NISP	94	65

height at withers for goat at Chak 86 calculated using the greatest length of the calcaneum (Table 5) after Joglekar (1991) was 65.20 cm. Occurrence of a second phalanx of the domestic ass *Equus asinus* in locus A1Qd.1, Stratum 4, at a depth of 1. 22 to 1. 35 m indicates its presence at the settlement and probable use as a beast of burden (Fig. 9). A negligible representation of wild animals is observed. From the fused nature of some of the bones, it is inferred that mostly adult animals were present in the collection.

Conclusions

Archaeological evidence indicates that though Tarkhanewala Dera and Chak 86 were located close to each other, they were occupied during different time periods. There was no contact between the cultures at these sites. Hence, although a more or less similar faunal assemblage is visible at the two sites it has, in a way helped trace animal exploitation patterns in this region through time. The faunal study revealed the predominance of domestic cattle bones at both sites. The presence of cut marks on these bones, and their charred condition indicates that cattle played a vital role in the food economy of the region since the Harappan period. Smaller domestic animals like sheep and goat also contributed to the food economy. Besides dietary use, all these animals might have been used in agricultural operations, obtaining dairy products, etc. Their presence strongly suggests an agriculture-based subsistence economy that was supported by pastoralism. At present, the Bikaner region, though a barren sandy tract, is renowned for its pasture land. Cattle, sheep and camels form the main source of income for pastoral communities living here. Similar situations might have been the case in the past.

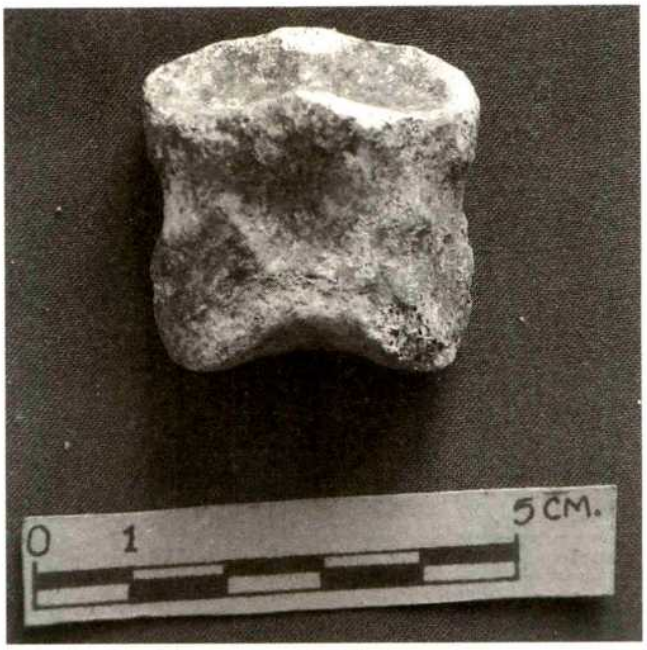

Fig. 9: A complete second phalanx of domestic ass (*Equus asinus*) from Chak 86

The occurrence of remains of aquatic animals like turtle and fish at Tarkhanewala Dera indicates exploitation of riverine animal resources during the Harappan period. A general absence of wild fauna at both sites has limited our understanding of their contribution and the general ecological conditions around these sites in the past. Nevertheless, the overall faunal evidence has helped show that during Harappan times in particular the Ghaggar river and its tributaries contained sufficient water to help support animal husbandry and stock rearing at many settlements.

List of abbrieviations used

SP: Species
BI: *Bos indicus* (Cow/Ox)
Oa: *Ovis aries* (sheep)
Ea: *Equus asinus* (Domestic Ass)
Tp: Thickness proximal,
Sd: Thickness of shaft
GLl: Greater length of Lateral half
WL: Width of Lateral
1: Maximum width
TWD: Tarkhanewala Dera
B/B: *Bos/Bubalis* (cattle)
Ch: *Capra hircus* (goat)
Bp: Breadth of proximal end
Bd: Breadth of distal end
Gl: Greatest length
GLm: Greater Length of medial half
WM: Width of Medial
2. Maximum height

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Table 4: Measurements of metacarpal and metatarsal from Tarkanewala Dera (in mm)

Sample	**Locus**	**Depth** (cm)	**Bone**	**Species**	Bp	Tp	Bd	Sd
TWD 26	B1Qd1 (4)	50-53	Metacarpal	Oa	-	-	23.20	14.10
TWD 31	B1Qd1 (4)	50-53	Metatarsal	Ch	21.15	-	-	-

Table 5: Calcaneum and teeth measurements of *Capra hircus* from Chak 86 (in mm)

Sample	**Locus**	**Stratum**	**Depth** (cm)	**Bone**	**GL**	**2**	**3**	**Lth**	**Width**
Chak 1	ZA1Qd2	2	33-40	Calcaneum	57.19	17.75	20.59	---	---
Chak 31	A1Qd1	2	42-52	m1/m2	---	---	---	40.45	17.28

Table 6: First and second phalanx measurements from Tarkanewala Dera and Chak 86 (in mm)

Sample	**Locus**	**Stratum**	**Depth** (cm)	**Bone**	**Species**	**GL**	**Bp**	**Tp**	**Bd**
TWD 19	XA1Qd3	1	10	PHII	Ch	18.80	11.62	---	9.56
Chak 10	A1Qd1	4	35-51	PHI	BI	51.61	23.82	24.15	18.66
Chak 2	ZA1Qd2	2	33-40	PHI	BI	---	---	---	23.50
Chak 19	ZA1Qd1	2	10-40	PHII	BI	45.76	29.00	32.28	24.64
Chak 22	A1Qd1	4	1.22-1.35	PHII	EA	27.46	33.46	---	32.46
Chak 23	A1Qd1	4	1.22-1.35	PHII	BI	---	29.58	32.59	---
Chak 30	A1Qd1	2	42-52	PHII	BI	---	25.31	27.40	23.87

Table 7: Astragalus measurements of *Bos indicus* from Tarkhanewala Dera and Chak 86 (in mm)

Sample	**Locus**	**Stratum**	**Depth** (cm)	**GLl**	**GLm**	**Bd**	**WL**	**WM**
TWD 28	B1Qd1	4	50-53	72.94	65.58	41.61	35.51	30.94
Chak 24	A1Qd1	4	1.22-1.35	---	57.35	37.34	28.81	---
Chak 27	A1Qd1	4	37-50	64.58	61.27	40.27	33.30	30.52
Chak 29	A1Qd1	4	37-50	66.06	61.22	40.10	29.20	30.68
Chak 8	ZA1Qd3	2	30-50	---	65.25	39.85	---	---

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Evolution of the Harappan Bullock Cart at Bhirrana, District Fatehabad, Haryana

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Abstract

Most of the published literature regarding the land transport mechanism prevailing during the Mature Harappan period speaks about pack animals and bullock carts with solid wheels. But not much information is forthcoming about the types of bullock cart that existed during the antecedent periods, like Early Mature Harappan, Early Harappan and Hakra Wares culture. However, the excavation of the Harappan mound at Bhirrana (29° 33' N; 75° 33' E) revealed for the first time, the introduction of the bullock cart during the Hakra Ware period which continued in later periods. This paper attempts to assess the various morphological changes as reflected in the terracotta toy cart frame models recovered at the site.

Introduction

Published literature places bullock carts and the pack animals as the main land transport mechanism during the Mature Harappan period is mostly attributed to the. As supportive evidence we have varieties of terracotta toy cart models recovered from large cities like Harappa and Mohenjo-daro, and several other excavated sites (see Marshal 1931; Mackay 1943: 162-65, 1938: 568-570; Vats 1940: 451-452). Besides, a few copper/bronze miniature carts have been reported from Harappa and Chanhu-daro. However, till date not much information is available on the bullock cart or any other mode of land transportation (other than pack animals) prior to the Mature Harappan period. It is a fairly established that there existed a chain of evolutionary stages long before the Mature Harappan stage. These evolutionary stages highlight the birth and growth of various aspects of Harappan culture. Similarly, bullock cart has undergone development as reflected in the antiquities recovered from the fourfold cultural sequence at Bhirrana.

Period IA: Hakra Ware Culture: Sled-like Frame (Figs. 1. 2; 4. 2)

From the Hakra Ware period we have a fragment of an unbaked hand-made, rectangular sled-like frame of a solid variety with its corners rounded off. The upper surface of this object bears a thumb impressed shallow depression. This was a rudimentary technique which became very popular in producing box-like and caneo-type of cart-frames during the succeeding Early Harappan period. The extant frame has a lone miniature perforation meant perhaps, for a side upright on one of its lateral margins of longer axis.

Period IB: Early Harappan Culture: Four Wheeled Box Type Cart (Figs. 1.3; 4. 3)

During the Early Harappan period we see the emergence of box type toy-carts. Bhirrana has produced a unique four-wheeled open box type terracotta toy cart with a projecting neck and head which looks like that of a bullock/goat/sheep. The entire body of the animal is converted into a rectangular and thick solid frame. When the clay was in leather-hard condition the upper surface of the animal body was subjected to two thumb impressions so as to form an open rectangular box-like body with sidewalls. The sidewalls have suffered minor flaking due to weathering. The lower half of the body is fashioned to resemble the conjoined front and hind legs of the animal. This figure should not be mistaken for terracotta-mounted animals whose bodies are depicted as closed hollow boxes. The legs have two bold perforations. The front one is damaged, but it was to receive axles holding two pairs of wheels. The axle-holes are not bored on par with each other. The rear axle-hole is at a higher level; thereby implying that the rear wheels were comparatively larger in size than those at the front. There is no perforation meant for the main shaft to which bullocks are yoked.

1. Two- wheeled box type cart (Figs. 1.4; 4. 4)

One more hand-made, but damaged rectangular, two-wheeled, open box type terracotta toy cart frame has been recovered from the Early Harappan levels. The extant portion represents the rear of the cart with high sidewalls and a flat bottom. The sidewalls are partly damaged. A bold axle-hole, perforated across the thickness of the frame must have existed. Due to breakage only the extant groove only can be seen.

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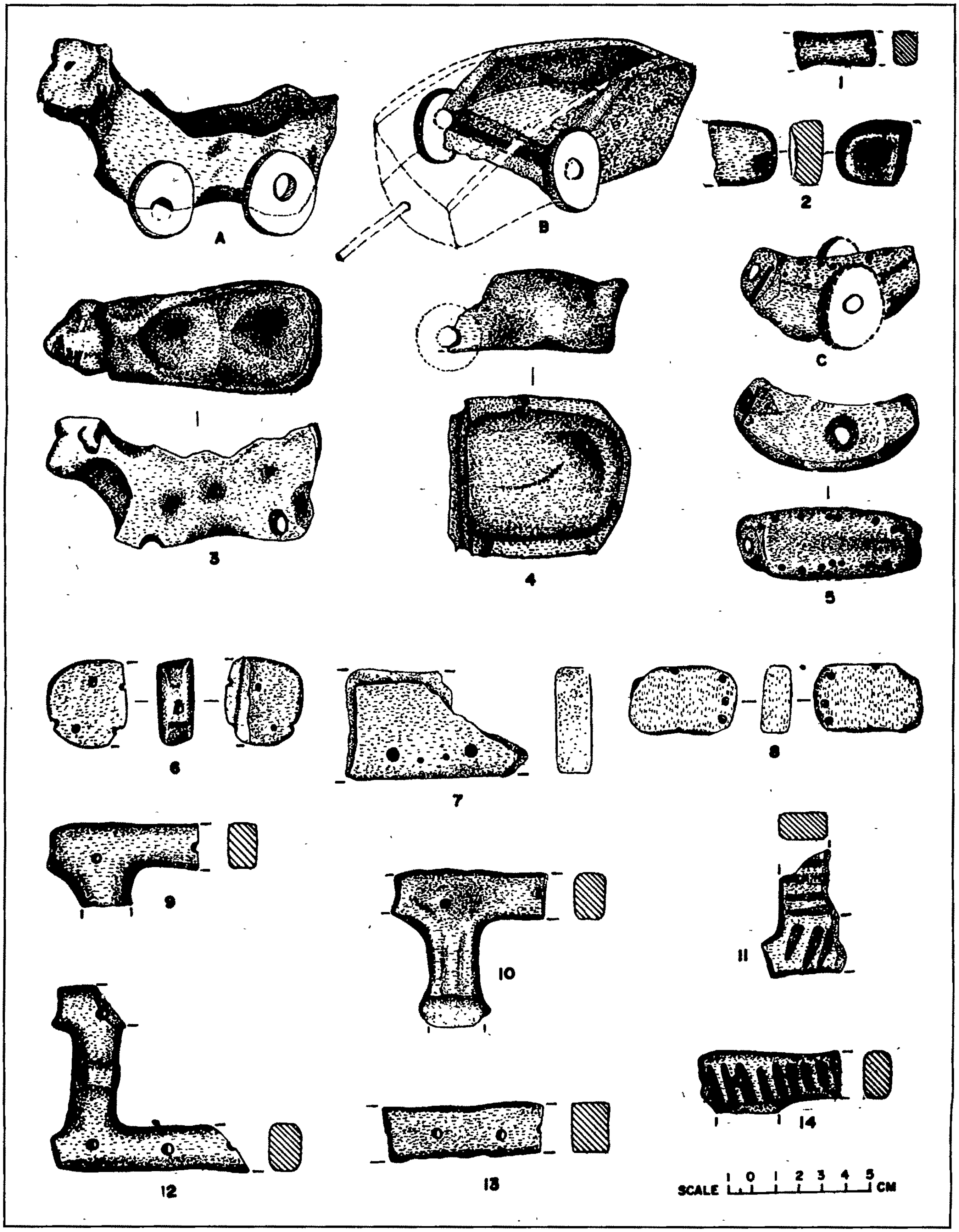

Fig. 1: Terracotta toy cart models 2. Hakra wares period; 1, 3-4 Early Harappan; 5 to 14 Early Mature Harappan period

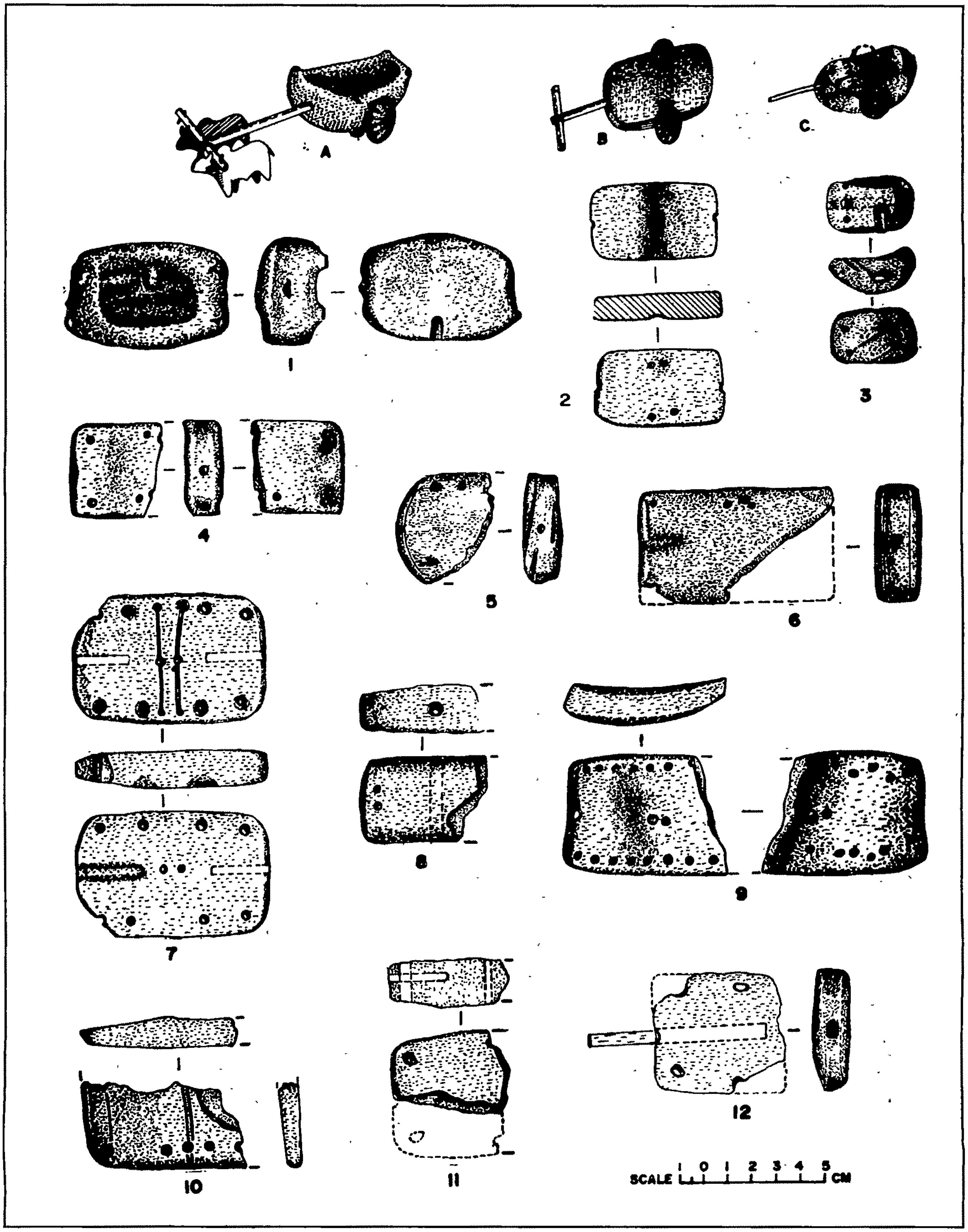

Fig. 2: Terracotta toy cart models of solid variety of the Mature Harappan period

2. Open- frame type cart (Figs.1.1; 4. 1)

It appears that during the Early Harappan Period, toy carts of the open–frame variety, were also in use. This is attested by a solitary fragment of a well-fired, medium thick lateral frame-bar with two damaged holes meant for side uprights. This kind of toy cart became popular during the Early Mature and the Mature Harappan periods.

Early Mature Harappan Period II A

During this period, further technological advancements in manufacturing bullock carts took place. Now, two kinds of bullock cart frame. These forms of bullock carts could have been extensively used for land transportation and communication in the succeeding Mature Harappan period.

1. Cart frame of solid variety (Figs.1. 5-8; 4. 5-8)
a) In this category the floor is flat, rectangular and solid with provision for a transverse hole pierced across the thickness of the frame (Figs. 1. 5, 6, 8) for the axle. On one of its shorter sides, a blind but deep perforation can be seen, which received the main shaft of the cart (Figs. 1.5-6; 4. 5-6). There is also a series of holes on its lateral margins meant for side-uprights (Figs.1. 5-8; 4. 5-8). Interestingly during this period, the axle, instead of passing through the hole, was retained at the bottom of the frame. Miniature holes were present through which lashes were suspended to fasten it tightly (Figs. 1.7; 4.7).

b) There exists one more variant of the solid cart frame. This resembles a boat with a shallow grooved base (Fig. 1.5). Holes for axle, side-uprights and main shaft are at their usual places.

2. Toy cart of open frame variety (Figs. 1.9-14; 4. 9-14)

In this category, a rectangular frame of open variety is manufactured by assembling different pieces by luting. Although no intact frame of this kind was found,it can be reconstructed from available fragments. Generally, this type of cart consists of two lateral bars to which three middle pieces are attached (Figs. 1.9, 10, 12; 4. 9, 10, 12). This left behind two gaps within a sagging rectangular frame. However, such gaps might have been covered with nets (Mackay 1943: 162) since the painted meshwork frames indicates the presence of nets (Figs. 1.11-12; 4. 11-12). Invariably, in this type of frames the axle is placed below the middle three pairs of miniature holes provided at a regular distance. Lashes were inserted into these holes were tightly fastened to the axle. The lateral bars of the frame have holes at regular distance for fixing side-uprights.

Two incomplete terracotta carts from period III have been reported from Lewan in Bannu District (Pakistan). With regard to the dating of these carts along with other objects of the period, the excavator states that it dates "... partly to the Early Harappan periods and even perhaps partly to the Mature Harappan periods ...". (Allchin and Allchin 1993: 533), thereby implying that these cart frames belonged to the Early Mature Harappan or Transitional period.

Mature Harappan Period II B

Three types of toy cart frames have been recovered from the Mature Harappan period.

1. Two- wheeled toy cart of box type (Figs.2.1; 5.1)

These toy carts were present during the Early Harappan period. These are absent in the Early Mature Harappan period and reappear during the Mature Harappan Period. A solitary example from Bhirrana is intact with some damage. It is made of well-lavigated clay and fired red. It bears a thin brown slip coating. The basal portion of this frame does not bear a slip. It is rectangular in shape when viewed from the top, but it has a semi-circular base. The central portion of the cart was thumb-pressed when the clay was in leather hard condition, which resulted in a concavity with raised sidewalls. An axle hole at the base and a blind hole on the front face of the cart, for main shafts, is noted. The pre-firing telltale pierce-marks of an axle-hole and a shaft-hole are clearly visible on the floor of the cart. At all four corners of the cart projecting corner are present but damaged. These posts supported a canopy.

2. Two- wheeled toy carts of solid frame
(Figs. 2.2–12; 5. 2-12)

In general these solid frames are rectangular in shape, but in a few cases have rounded-off corners (Figs. 2.5, 7; 5. 5, 7). There is also a rectangular miniature toy cart frame of a solid variety with a thumb-pressed shallow concavity at the top, and a semi-circular base (Figs.2.3; 5.3). The general characteristics of these frames include a series of perforations on both the longer axis to receive side-uprights (Figs.2.4 -7, 9-11; 5.4-7, 9-11). However, there are a few exceptions of frames without holes for lateral uprights (Figs. 2.2, 8; 5.2, 8). In the case depicted in Figs. 2.2; 5.2, the two pairs of holes in the middle of the frame were meant for lashes to fasten the axle. Whereas the holes provided (Figs. 2.8; 5.8) on the shorter side of the frame were probably used for lashes to fasten the central shaft of the cart. Otherwise on one of the shorter sides a blind perforation exists to hold main shaft. An exception is seen in some cases (Figs. 2.7; 5.7). Here blind holes are provided on both the shorter faces. In a majority of cases the axle was fixed below the frame (Figs. 2.2, 4-7, 9-10; 5.2, 4-7, 9-10) with the help of lashes, for which special set of paired holes were provided along the lateral margins and the middle of the frame. However, the practice of inserting an axle across the thickness of the frame still existed (Figs. 2.3, 8, 11; 5.3, 8, 11). All these frames are hand-made and

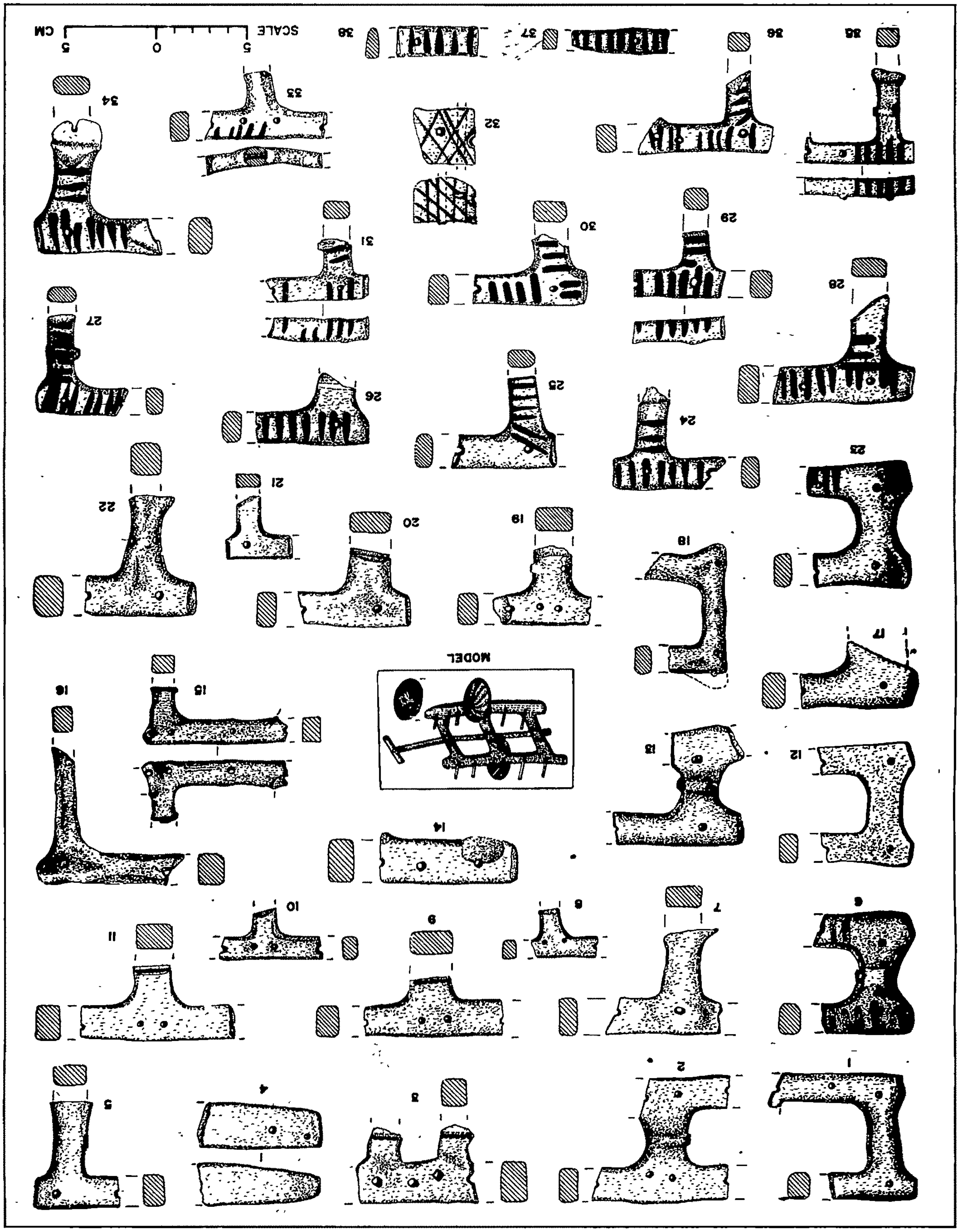

Fig. 3: Terracotta toy cart models of open variety of the Mature Harappan period

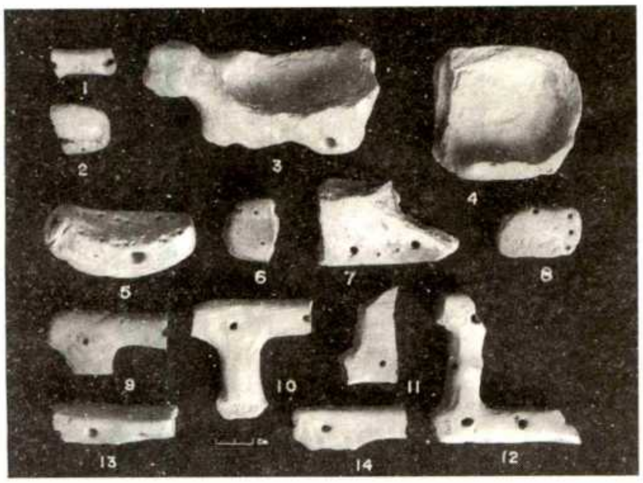

Fig. 4: Terracotta toy cart models 2. Hakra wares period; 1, 3-4 Early Harappan; 5 to 14 Early Mature Harappan period

a majority are well-fired. Interestingly, the frontal portion of these frames is invariably thinner in comparison to the rear and middle portions.

3. *Two-wheeled toy cart of open frame type*
(Figs. 3.1-38; 6.1-38)

In this category there are no technical changes in fabrication, including use of painted net to fill gaps existing within the frame (Figs. 3.6, 23-38; 6.6, 23-38). There was a proliferation of carts as indicated by the number of such examples found at Bhirrana.

Discussion

Methods of land transportation are mainly governed by the topography of a given region. In mountainous regions such as Baluchistan, negotiating hilly tracts was a daunting task. Hence, only pack animals were used for transportation of material goods. During the 5th and 4th millennium B.C., the Neolithic-Chalcolithic communities of the piedmont regions of Baluchistan gradually began to migrate to the Indus-Saraswati alluvial plains. As a result, we have a number of Neolithic-Chalcolithic villages such as Amri, Gazhi Shah, Harappa, Jalilpur, the Hakra Ware settlements in the Hakra region, Bhirrana, Kunal, etc. The new topography, i.e. alluvial plains of the Indus-Saraswati, despite seasonal floods enabled free mobility. The users of Hakra wares at Bhirrana, introduced for the first time, a sled-like device made from unbaked clay. By harnessing a pair of cattle to the real sled/cart they could transport large quantities of goods over longer distances.

The Early Harappan period at Bhirrana witnessed the birth of a full-fledged toy cart model of the box type with an axle. It is important to note that both four-wheeled and two-wheeled box type carts were in use. The cart frame of open-variety with provisions for side uprights, also makes its appearance during this period. On the contrary, we have virtually no information on terracotta toy cart remains from major excavated type sites of the Early Harappan period such as Kot Diji, Amri, Kalibangan, Mitathal and Banawali. However, Rakhigarhi yielded toy cart frames of this period (Nath 2001-02: 44). In this context it is interesting to note that at Banawali there is an Early Harappan potsherd decorated with a "canopied cart with spoked wheels" in black painting (Bisht 1993: 116). However, a fresh study of this painting revealed that these are not spoked, but solid wheels (Rao 2005-06: 64). We have terracotta toy wheel models of a solid variety of the Early Harappan period from sites such as Kalibangan (Lal *et al.* 2003: 231) Bhirrana (Rao 2005-06: 60), Rakhigarhi, (Nath 2001-02: 44). Gumla, Rehaman Dheri, Tarakai Quila (Allchin and Allchin 1997: 150, Pl.43). Thus, carts with solid wheels were the order of the day.

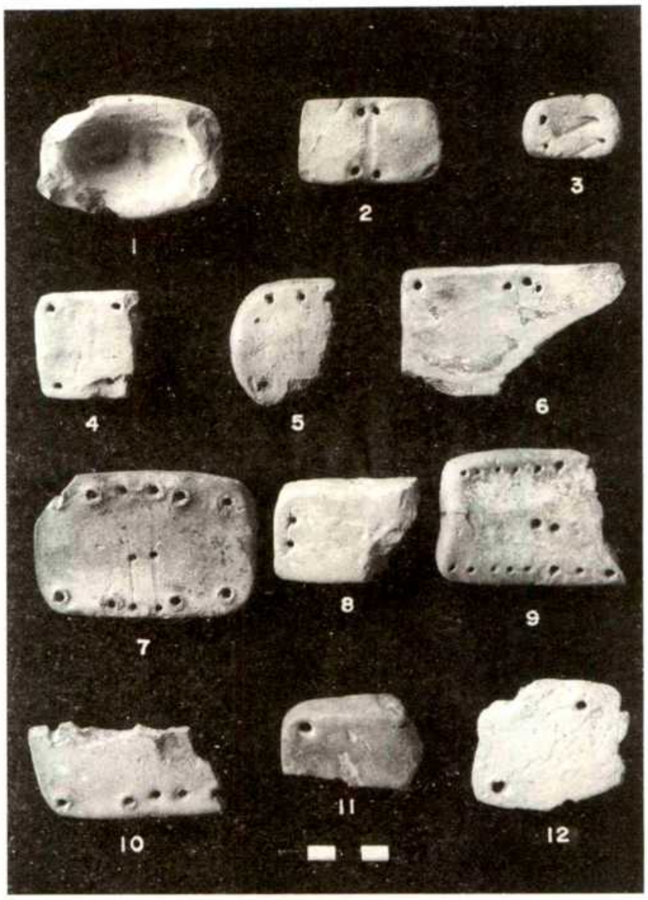

Fig. 5: Terracotta toy cart models of solid variety of the Mature Harappan period

The Early Mature Harappan period has proved to be a crucial stage in the growth of Harappan civilization. Now, for the first time the solid cart frame, bearing holes for the main shaft, and miniature holes for side-uprights, was used. In this category, the axle was also inserted into a transverse hole, as was the case with the box type carts. Another system is noted where the axle is placed beneath

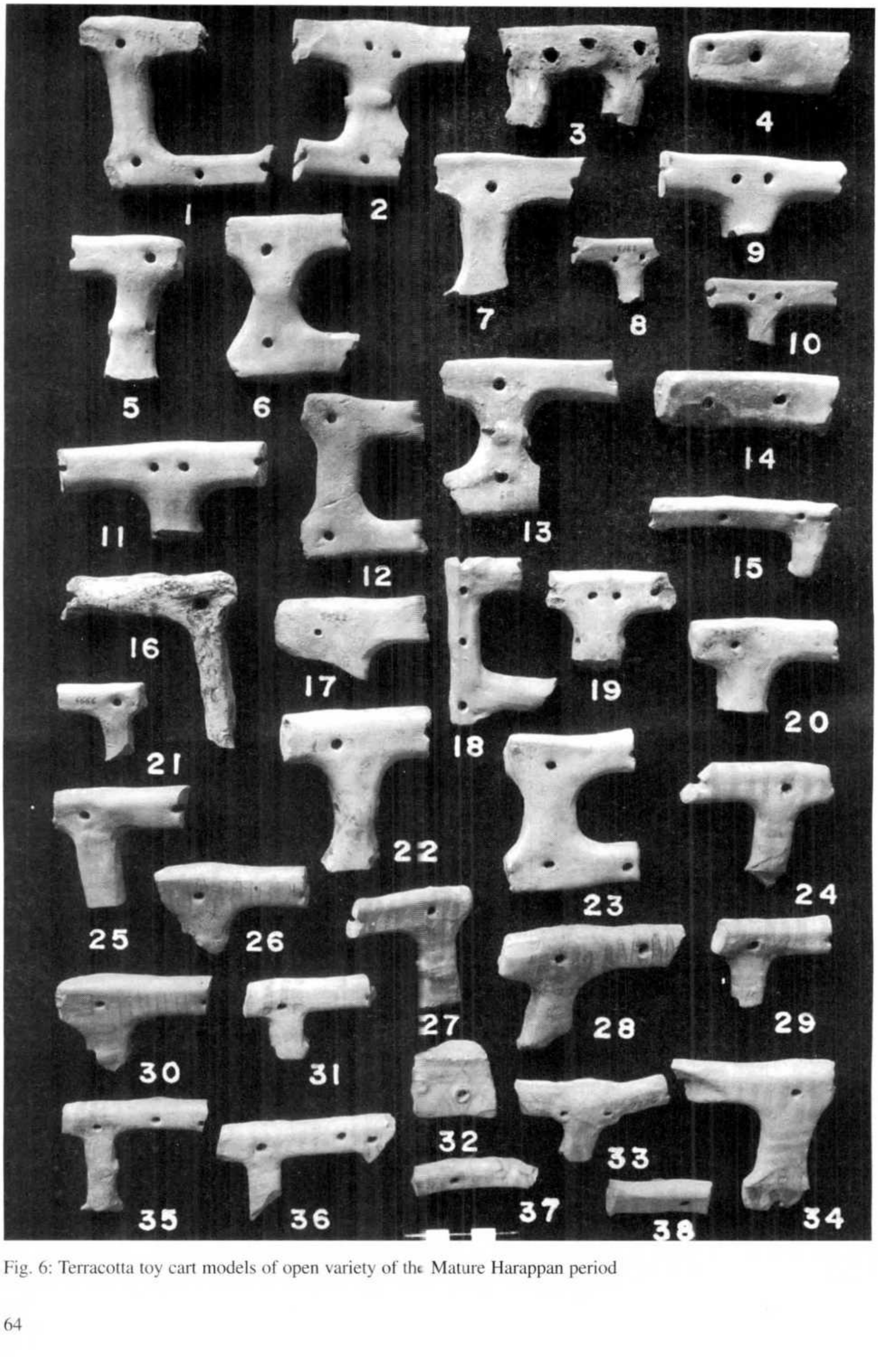

Fig. 6: Terracotta toy cart models of open variety of the Mature Harappan period

the frame. Here two or three pairs of perforations provided in the middle of the frame. The terracotta cart frame of the open variety also had axles in similar positions for inserting lashes. The latter technology was an improvement over the former, since the freed axle would not make any noise during movement. However, no box type carts were found from this period.

From the Mature Harappan Period we have one specimen of a conventional box type cart. The axle was placed in the transverse hole provided for it. Within the terracotta solid cart frame one can see both practices of placing the axle within the provided hole or below the frame with provision for lashes for fastening. However, from the available evidence it appears that the latter technique became popular. There is continuity in the manufacturing technology of frames of carts of the open variety.

At Bhirrana, spoked wheels were introduced during the Early Mature Harappan period (Rao 2005-06: 60). The Early Mature Harappan or Transition period has proved to be a crucial stage in the development of Harappans from rural/town-life to that of city-life as reflected at Banawali IC, Dholavira stage IV and Bhirrana IIA. Greater stress was laid on building infrastructure such as land transportation and communication systems. In this process, introduction of spoked wheels combined with the light weight carts of the open frame variety could have generated greater pace and mobility. This, in turn helped in accelerating trade and commerce over the vast Harappan territory. This does not mean that slower solid frame carts and solid wheels went out of use. This is evident at Bhirrana since both the types of carts continued to be used.

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New Insights into Harappan Town-Planning, Proportions and Units, with Special Reference to Dholavira*

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Abstract

Dholavira's elaborate town-planning rests on the conscious use of specific proportions for its successive enclosures. Those proportions combined with the city's dimensions allow us to calculate precisely the unit of length used for the fortifications, to relate it to the Lothal ivory scale, and to work out potential subunits. Both proportions and units receive overwhelming confirmation from structures of Dholavira and other Harappan sites. Units are finally refined to a *dhanus* of 190.1 cm and an *angula* of 1.76 cm, the former being 108 times the latter. The Dholavirian scheme of units is then shown to be related to historical unit systems in several ways; in particular, the *Arthashastra*'s scheme of linear measures conclusively has Harappan roots. Finally, the paper attempts to outline some of the abstract concepts underlying Dholavira's geometry, taking a peep at a hitherto neglected component of the Harappan mind.

Dholavira's Ratios

Unlike most Harappan cities, Dholavira in the Rann of Kachchh (23° 53' 10" N; 70° 13' E), excavated by R.S. Bisht in the 1990s, presents us with a largely undisturbed plan and clearly delineated multiple enclosures covering about 48 hectares. This fascinating site displays two marked specificities. While Harappan town-planning is usually based on a duality acropolis / lower town, Dholavira's plan (Fig. 1) is triple: an acropolis or upper town consisting of a massive "castle" and an adjacent "bailey," a middle town (including a huge ceremonial ground), and a lower town, a large part of which was occupied by a series of reservoirs. (Throughout this paper, terms such as "castle," "bailey," "granary," "college," etc., have been used with quotation marks to remind the reader that they are conjectural in nature; similarly, the neutral term "acropolis" has been preferred to the misleading "citadel," as it is now largely accepted that the upper town in Harappan settlements had no inherent military purpose; in the same spirit, "fortifications" has been preferred to "defences.")

Table 1 summarizes the city's dimensions, as supplied by the excavator (Bisht 1997, 1999, 2000), with a maximum margin of error of 0.5% (Bisht 2000: 18). Because these figures are our primary data on which all further calculations of margins of error will depend, they have not been rounded off and are quoted as published.

Table 1: Dholavira's dimensions

Dimension	Measurement (in m)	
	Length	Width
Lower town (entire city)	771.1	616.85
Middle town	340.5	290.45
Ceremonial ground	283	47.5
"Castle" (inner)	114	92
"Castle" (outer)	151	118
"Bailey"	120	120

Dholavira's second specificity is the conspicuous use of precise ratios or proportions in the various enclosures. Bisht highlighted some of them as follows (added in parentheses are margins of error calculated on the basis of Table 1 and rounded off to the first decimal):

1. The "**castle**" also reflects the city's ratio of **5 : 4** (0.9% inner, 2.4% outer);
2. The "**bailey**" is square (ratio **1 : 1**);
3. The **middle town**'s length and breadth are in a ratio of **7 : 6** (0.5%);
4. The **ceremonial ground**'s proportions are **6 : 1** (0.7%);

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* This paper is dedicated to the memory of the late Dr. S.P. Gupta, whom I was lucky to know and to learn from over a decade.

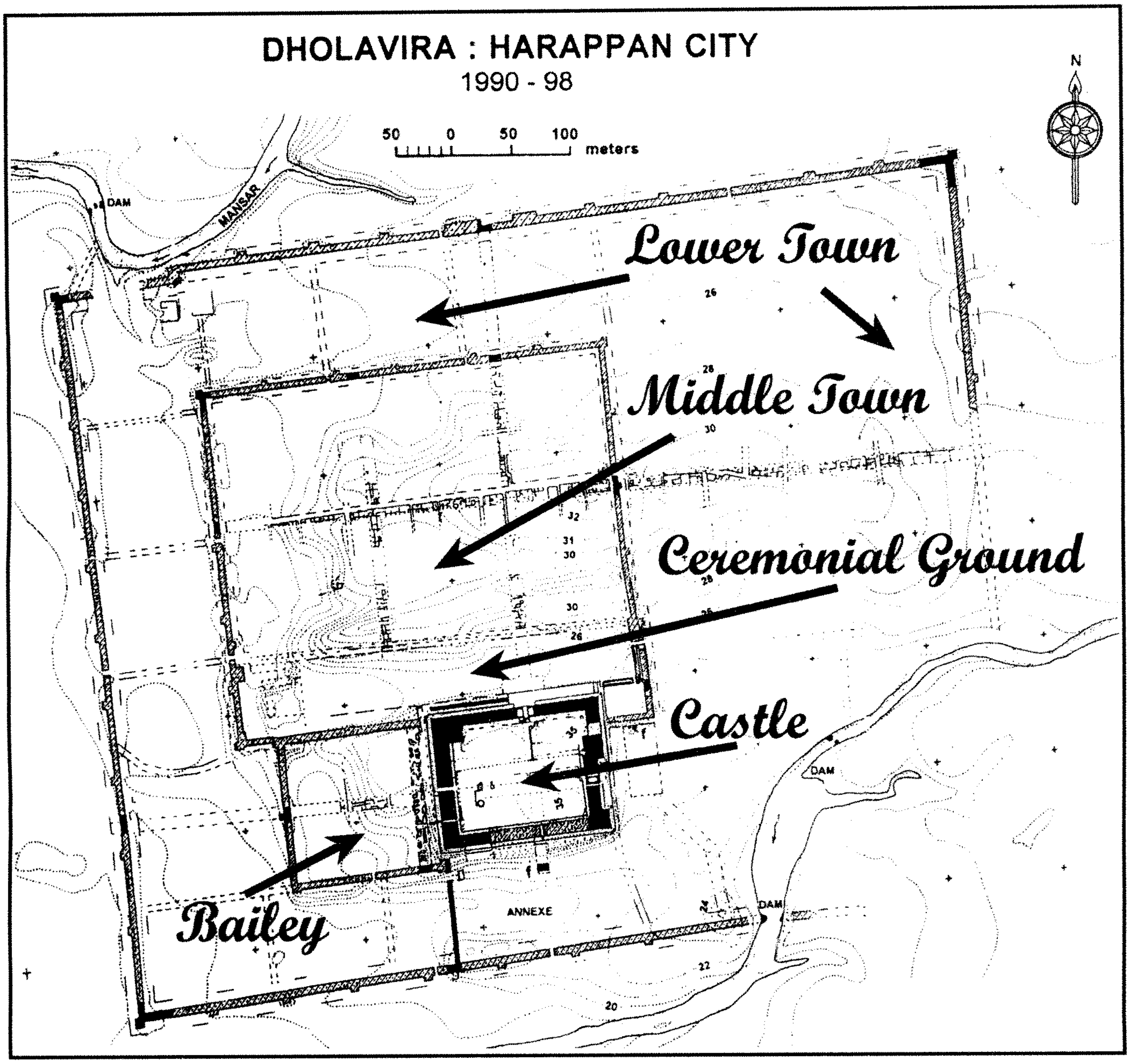

Fig. 1: Plan of Dholavira (adapted from Bisht 1999)

5. The **city**'s length (east-west axis) and width (north-south) are in a ratio of **5 : 4** (0.0%, a perfect match).

All but one ratio are verified within 1%, an excellent agreement considering the irregularities of the terrain and possible erosion and tectonic movements in the course of millennia. The exception, the outer dimensions of the "castle," can be explained by the fact that this monumental stone structure, which formed the earliest part of the city, was altered when the middle town was added shortly before the mature phase, so as to bring its dimensions in line with the desired proportions 5 :4, while other enclosures were directly built to plan.

In two earlier papers (Danino, 2005 and in press), a few other important ratios at work in Dholavira were worked out, some as "axioms" (i.e., basic proportions that the town-planners would have chosen in order to define the whole city geometrically), others as consequences of those basic choices, so that all the ratios are interrelated in a mathematically consistent system:

1. The castle's outer and inner lengths are in the ratio of **4 : 3** (verified within 0.7%).
2. The width of the castle's eastern and western fortification walls (half of the difference between the outer and inner lengths) is **1/8**th of the outer length and **1/6**th of the inner length (the last fraction identical to the

proportions of the ceremonial ground). Margins of error are 2% and 2.7%, a little high but acceptable in view of the irregularities of the castle's fortifications: their calculated dimensions are only averages.

3. The middle town's length and the castle's internal length are in the ratio of **3 : 1** (0.4%).
4. The middle town's length and the castle's outer length are precisely in the ratio of **9 : 4** (0.2%).
5. That the above ratio is a conscious choice is made clear by its repetition: the city's length and the middle town's length are in the same ratio of **9 : 4** (0.6%). In other words, the length of the city is to that of the middle town what the length of the middle town is to that of the "castle" — clearly no accident. We will return to this fundamental principle of recursion.
6. The middle town's length and the ceremonial ground's length are in the ratio **6 : 5** (precisely verified within 0.3%).
7. A few more ratios play a role in the complete picture, notably **3 : 2**.

Here again, margins of error are so small that such ratios cannot by any means be accidental. The principal ones are summarized in Fig. 2 and Table 2.

Dholavira's Master Unit of Length

With such a set of precise ratios and dimensions, we can work out the unit of length that was used to measure out the city's enclosures. Let us call it "D" for Dholavira.

Table 2: Dholavira's ratios and margins of errors

Dimensions	Ratio	Margin of error (%)
"Castle," inner*	5 : 4	0.9
"Castle," outer*	5 : 4	2.4
"Bailey"*	1 : 1	0.0
Middle town*	7 : 6	0.5
Ceremonial ground*	6 : 1	0.7
Lower town (entire city)*	5 : 4	0.0
Castle's outer to inner lengths**	**4 : 3**	0.7
Middle town's length to castle's internal length**	**3 : 1**	0.4
Middle town's length to castle's outer length**	**9 : 4**	0.2
City's length to middle town's length**	**9 : 4**	0.6
Middle town's length to ceremonial ground's length**	**6 : 5**	0.3

* = proposed by R.S. Bisht,

** = proposed by Michel Danino

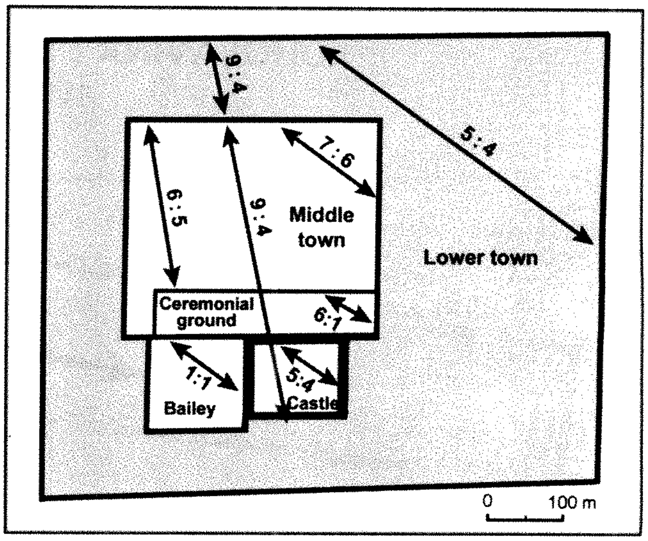

Fig. 2: Main ratios at work in Dholavira

In a previous paper (Danino, in press), a simple procedure was used to calculate, with no *a priori* assumption, the largest possible value of D that will result in most of the city's dimensions being expressed as integral (or whole) multiples of D. The procedure, briefly put, consists in algebraically expressing the smallest dimension in our scheme (i.e., the average width of the castle's western and eastern fortifications) as a multiple of the unknown unit D (or "n times D," n being an integer); then, using the precise ratios noted above, to work out the larger dimensions and express all of them in terms of "n times D." For instance, the castle's outer length, which, as we saw, is 8 times the width of its fortifications, becomes 8 nD. But while most dimensions now become integral multiples of "n times D," a few are fractional expressions. To make those fractions disappear, all we have to do is choose "n" as the least common multiple of their denominators. It turns out that with n = 10, all fractional results disappear, except one.

Going back to our initial formula, the width of the castle's western and eastern fortifications, which we expressed as "n times D," is now 10 D. Bringing into play the proportions listed above, the castle's inner dimensions become 60 D x 48 D, outer dimensions 80 D x 64 D, the bailey 63 D x 63 D, the middle town's length 180 D, the ceremonial ground 150 D x 25 D, and the lower town 405 D x 324 D. (The only non-integral multiple of D in this scheme is the middle town's width, equal to 6/7th of the length and therefore about 154.3 D.) A few additional dimensions were worked out in terms of D, which need not be detailed here. Fig. 3 summarizes Dholavira's dimensions in terms of D.

It only remains to determine the value of D, which is done with the greatest precision by deriving it from the city's largest dimension, the length of the lower town: if 771.1 m = 405 D, then D = 1.904 m or 190.4 cm.
To remove any doubt regarding the soundness of our

Table 3: Comparison between theoretical and actual dimensions

Dimension	Length (in terms of unit D)	Theoretical measurement (in m)	Actual measurement (in m)	Margin of error (%)
Lower town's length	405	771.1	771.1	0.0
Lower town's width	324	616.9	616.85	0.0
Middle town's length	180	342.7	340.5	+0.6
Middle town's width	154.3	293.8	290.45	+1.1
Ceremonial ground's length	150	285.6	283	+0.9
Ceremonial ground's width	25	47.6	47.5	+0.2
Inner castle's length	60	114.2	114	+0.2
Inner castle's width	48	91.4	92	- 0.7
Outer castle's length	80	152.3	151	+0.9
Outer castle's width	64	121.9	118	+3.2
Bailey's length & width	63	120.0	120	0.0

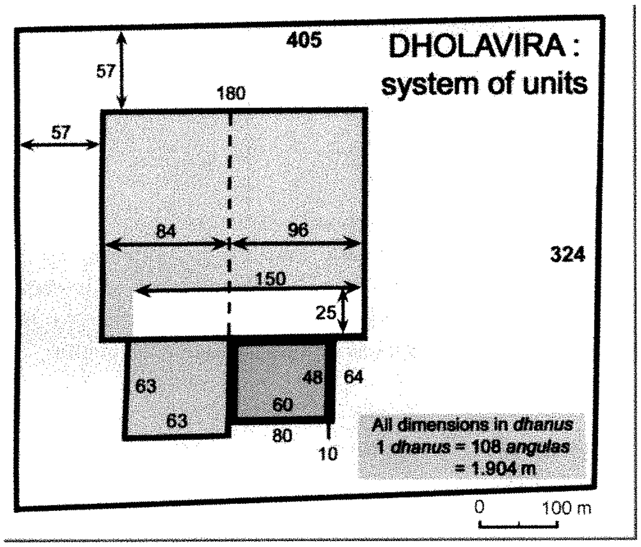

Fig. 3: Dholavira's main dimensions expressed in terms of dhanus, Dholavira's master unit of length

scheme of units and ratios, all we have to do is to start afresh from D = 1.904 m, calculate the theoretical dimensions using Fig. 3, and compare with the actual dimensions supplied by Bisht. Table 3 summarizes the results, as well as the margin of error between theoretical and actual dimensions.

Margins of error are remarkably modest, 0.6% on average, the highest being, again, in the outer dimensions of the "castle"; if we leave them aside, the average margin of error drops below 0.4%. These almost perfect matches evidenced by large structures rule out the play of chance.

It is important to note that from a mathematical perspective, what we have done so far is merely *to calculate the largest possible unit in terms of which all dimensions will be expressed as integers* (except one, the middle town's width, for reasons explained in Danino, in press). Our sole assumption is that Dholavira's architects would have planned the city's dimensions as integral multiples of their unit (48, 60 ...) rather than as non-integral ones (e.g. 48.4, 60.3 ...), a natural expectation for aesthetical as well as pragmatic reasons. It will be amply confirmed in the next sections when we find integral multiples of D at work in other Dholavirian structures and further afield in other Harappan cities.

Ratios in Harappan Settlements

Let us first examine other Harappan cities and structures in the light of our Dholavirian scheme of ratios. (In the rest of this paper, whenever published dimensions are stated or implied to be approximate, no margin of error has been added as mathematically such a margin would not be significant.)

Dholavira's nested enclosures appear to be in a class of their own. Wherever fortifications have been traced in other sites, an overall ratio of **1 : 2** is the most common: **Kalibangan**'s acropolis is 120 x 240 m (Lal 1997: 122), while **Surkotada**'s overall dimensions are 130 x 65 m (Lal 1997: 135). We find the same ratio in **Mohenjo-daro**'s acropolis, which rests on a huge brick platform measuring 400 x 200 m (Jansen 1988: 134), although whether the acropolis was ever fortified remains unclear. The division of Kalibangan's acropolis and of Surkotada into two equal halves does broadly recall the complex formed by Dholavira's "bailey" and "castle," but that is as far as we can get.

However, when we study a variety of structures from other Mature Harappan sites, we find many of Dholavira's chief ratios unmistakably in use:

Ratio 3:1 is found at Mohenjo-daro's "college" whose average dimensions are 70.3 x 23.9 m (Mackay 1938: 10).

Ratio 3:2 is the overall ratio of Kalibangan's lower town (approximate dimensions 360 x 240 m) (Lal 1998: 119), as well as of a sacrificial pit (1.50 x 1 m) (Lal 1998: 96). It is also the ratio (within 1.7 %) of a reservoir in Dholavira's "castle" measuring 4.35 x 2.95 m (Lal 1998: 43). We find it again (within 1%) at Mohenjo-daro in the massive platform of the "granary" (also called "warehouse"), which measures 50 x 33 m (Jansen 1979: 420).

Ratio 4:3 is visible in Mohenjo-daro's "granary": this structure is composed of 27 brick platforms (in 3 rows of 9); while all platforms are 4.5 m wide (in an east-west direction), their length (in a north-west direction) is 8 m for the first row, 4.5 m for the central row, and 6 m for the third row (Jansen 1979: 420). It is singular that both pairs (8, 6) and (6, 4.5) precisely reflect the ratio 4 : 3.

Ratio 6:1 is reflected in Lothal's dockyard (average dimensions 216.6 x 36.6 m) (Rao 1979: 1:123).

Ratio 5:4, Dholavira's prime ratio, is found at two settlements in Gujarat: Lothal, whose overall dimensions are 280 x 225 m (Lal 1997: 129); and Juni Kuran (just forty kilometres away from Dholavira in Kachchh), whose acropolis measures 92 x 72 m (Chakrabarti 2006: 166), which approximates 5 : 4 by 2.2%. Ratio 5 : 4 is also found in structures elsewhere: in Harappa's "granary" of 50 x 40 m (Kenoyer 1998: 64); and in a major building of Mohenjo-daro's HR area measuring 18.9 x 15.2 m (Dhavalikar and Atre 1989: 195-97), thus with a precision of 0.5%.

Ratio 5:4 is repeated in other ways. At Dholavira, for instance, there are 5 salients on the northern side of the middle town's fortification, against 4 on its eastern and western sides, a clear reminder, should one be needed, of this ratio's pre-eminence. (If we include the corner salients, their numbers grow to 7 and 6, which reflect the middle town's ratio.) Returning to Mohenjo-daro, the "assembly hall," also called "pillared hall," located on the southern part of the acropolis, had four rows of five pillars each (Jansen 1988: 137).

Ratio 7:6, the ratio of Dholavira's middle town, is evidenced in the dimensions of the very same "pillared hall," which measures "approximately 23 by 27 metres" (Possehl 2002: 194). It is quite intriguing that this hall, in its dimensions (7 : 6) as well as rows of pillars (5 : 4), should reflect Dholavira's two key ratios!

Ratio 9:4 is found at Mohenjo-daro's long building located just north of the Great Bath, called "block 6" and measuring approximately 56.4 x 25 m (Mackay 1938: 17), thus within 0.3%.

The above examples are no more than a first sampling and call for a more systematic study, but they do show that Dholavira's ratios are not exclusive to it and are part of a broader Harappan tradition of town planning and architecture. So far, in fact, we have found 7 of Dholavira's 10 ratios at other sites.

In addition, more ratios emerge from other sites, for instance:

At Harappa, the "granary" has 12 rooms measuring 15.2 x 6.1 m each (Kenoyer 1998: 64), i.e., in a ratio of **5 : 2** (0.3%). Near mound AB, "14 symmetrically arranged small houses" were found, each measuring 17.06 x 7.31 m (Chakrabarti 2006: 156), i.e. in a perfect ratio of **7 : 3**.

At Gola Dhoro, a small fortified settlement near Bagasra on the Gulf of Kachchh in Gujarat, has a shell workshop measuring 5.6 x 3.2 m (Bhan *et al.* 2005), exactly in a ratio of **7 : 4**.

Until hundreds of such cases are studied and clear patterns brought out through statistical comparisons, what can safely be said at this stage is that Harappan architects and masons did not believe in haphazard constructions, but followed precise canons of aesthetics based on specific proportions.

Dimensions in Harappan Settlements Expressed in Terms of D

Ratios apart, we should expect Dholavira's unit D = 1.904 m reflected elsewhere: indeed examples abound, beginning with dimensions quoted in the previous section. A few more are proposed below, but it should be kept in mind that most of the following dimensions have clearly been rounded off by the authors referred to; therefore any agreement within 1 or 2% may be considered satisfactory. (A more problematic situation occurs when different authors publish different measurements for the same dimensions; it is hoped that the most reliable ones have been selected here.)

Mohenjo-daro: We saw above a major building in the HR area measuring 18.9 x 15.2 m, which is neatly expressed as **10 x 8 D** (0.7%, 0.2%); the "college" is 70.3 m long, precisely **37 D** (0.2%); "block 6" is about 56.4 m long, i.e. **30 D**; and the "pillared hall" (23 x 27 m) is **14 x 12 D**. According to Possehl (2002: 101), Mohenjo-daro's "First Street" is 7.6 m wide, which is exactly **4 D** (0.2%); the

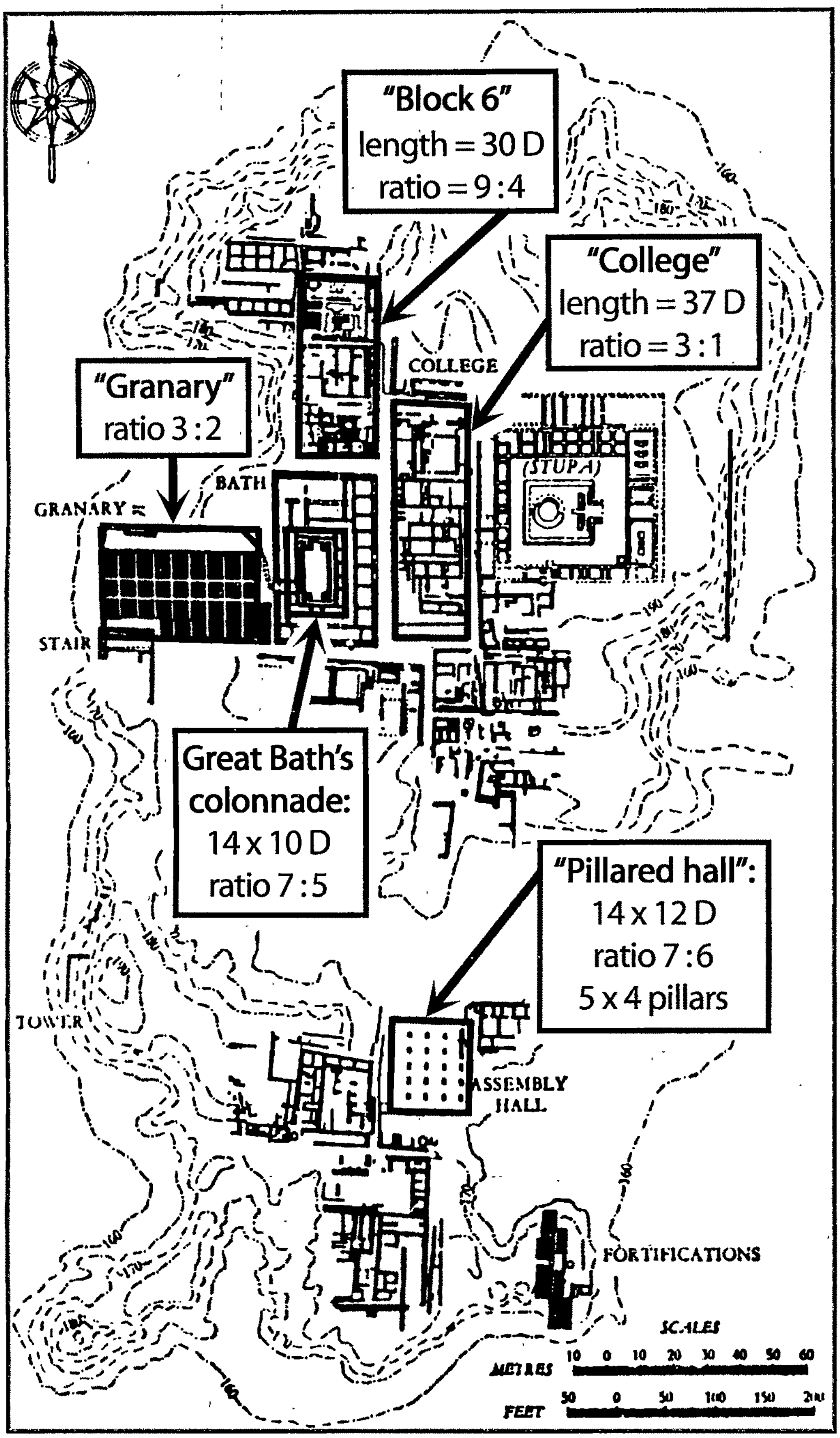

Fig. 4: Mohenjo-daro's acropolis: a few ratios and dimensions expressed in terms of Dholavira's unit D = 1.9 m

"Central Street," 5.5 m wide, is nearly **3 D** (3.8%); a smaller street jointing "First Street" is 3.8 m wide, or exactly **2 D** (0.2%).

Kalibangan: As we saw, the acropolis measures about 120 x 240 m, which is equivalent to **63 x 126 D**. Note also that the first dimension is identical to the inner dimensions of Dholavira's "bailey," while the second is also the width of Kalibangan's lower town.

Harappa: We mentioned that the "granary" measures 50 x 40 m, the smaller side being exactly **21 D** (0%); each of its 12 rooms is 15.2 x 6.1 m, or **8 D** lengthwise (0.2%). We also mentioned 14 small houses each 17.06 m long, which is precisely **9 D** (0.4%).

Gola Dhoro: The excavators give its inner dimensions as "approximately 50 x 50 m" (Bhan *et al.* 2005); a more precise reading of its plan yields 52.7 x 45 m, and outer dimensions of 64.6 x 56.4 m (averaging opposite sides, as the plan is not perfectly square); the latter dimensions are very close to **34 x 30 D**. The shell workshop, mentioned earlier, is 5.60 m long, which translates as **3 D** (2%).

Chanhu-daro: This important Harappan town in Sind has a street 5.68 m wide (Chakrabarti 2006: 154), which is precisely **3 D** (0.6%).

Lothal: The above-mentioned dockyard (average dimensions 216.6 x 36.6 m) can be precisely expressed as **114 x 19 D**.

Dholavira: Finally, a few compelling cases come from **Dholavira** itself: a large rock-cut reservoir, south of the "castle," measures 95 m x 11.42 m (Bisht 1999: 28) or very precisely **50 x 6 D** (0.2%, 0%); while the length is a minimum, and the width, measured at the top (it is a bit narrower at the bottom) gives us a remarkably perfect match. At the eastern end of a broad street traversing the "castle" stand two pillars 3.8 m apart (Lal 1998: 44); that is exactly **2 D**. The middle town's major north-south street is 5.75 m wide (Lal 1998: 44); that is almost exactly the same width as Chanhu-daro's street, and therefore **3 D** (0.7%).

Naturally, every single dimension cannot be expected to be a whole multiple of D; it is therefore striking enough that so many should turn out to be. This makes a strong case for Dholavira's unit to have been one of the standards in the Harappan world, at least as far as town-planning and architecture are concerned.

The Case of the Great Bath

The difficulty in obtaining reliable measurements for important structures finds an apt illustration in the case of Mohenjo-daro's famous Great Bath. Its discoverer, John Marshall, gave the dimensions of the central bath as 39 x 23 feet (1931: 24), which appear suspiciously rounded off; Mainkar (1984: 147), translating feet into metres, has 11.89 x 7.01 m. Kenoyer (1998: 63) offers approximately 12 x 7 m, probably from the same dimensions supplied by Jansen (1978/1997: 227); elsewhere, however (Jansen 1988: 134), the latter proposes 11.7 x 6.9 m. A careful measurement by this author of a digital scan of a precise isometric plan of the complex made after Marshall (Possehl 2002: 189) yielded averages of 12.1 x 7.1 m. Such substantial differences rule out a precise study, but temporary dimensions of 6¼ or $6^{1/3}$ x $3^{2/3}$ D (equivalent to 11.9 or 12 x 7 m) may be proposed.

Of greater interest is the colonnade surrounding the bath, consisting of 10 columns along the length and 7 along the width. A digital study by this author of the above-mentioned isometric plan yielded averages of 26.7 x 18.9 m, which happen to be precisely **14 x 10 D**. This introduces a ratio not found so far in our studies, **7 : 5**. Fig. 4 illustrates most of our findings at Mohenjo-daro's acropolis.

Dholavira's *Dhanus* and *Angul*

A unit never exists singly, however; it is always part of a system. D = 1.904 m would plainly be inconvenient to measure out bricks, walls or even small rooms. In order to determine its subunits, let us turn to divisions on the three known Harappan scales: those of Mohenjo-daro (6.7056 mm), Harappa (9.34 mm) (Mainkar 1984: 146), and Lothal (1.77 mm). The last is evidenced on an ivory scale found at Lothal, which has 27 graduations covering 46 mm. (Both S. R. Rao (Rao 1979: (2) 626) and V. B. Mainkar erred in dividing 46 mm by 27, when the length must of course be divided by the 26 divisions formed by the 27 graduations.)

Dividing D by the first two units yields no clear result. Dividing it by the Lothal unit, we get 1075.7, or, with an approximation of 0.4%, 1080. This last number can be written 108 x 10. So expressed, D begins to make sense as 108 times 1.77 cm. But what is so special about 1.77 cm? First, let us remember that the values of the traditional digit

Table 5: Comparison of two pairs of units

Structure	Expression in *dhanus*	Margin of error with Dholavira units (%)	Margin of error with Mohenjo-daro units (%)
Rock-cut reservoir at Dholavira	50 x 6	0.2, 0.0	0.0, 0.1
Rooms of Harappa's "granary"	8 (length)	0.2	0.0
Houses at Harappa (row of 14)	9 (length)	0.4	0.3

in the ancient world, be it in Egypt, Mesopotamia, China, Greece, Japan, or the Roman Empire, fluctuated between 1.6 and 1.9 cm (Rottländer 1983: 205); 10 times the Lothal unit falls precisely in that range.

Then, the *Arthashastra* defines a digit (*angula* in Sanskrit) as eight widths of barley grain (2.20.6) or "the maximum width of the middle part of the middle finger of a middling man" (2.20.7) (Kangle 1986: 138). Some eight centuries later, Varahamihira's *Brihat Samhita* (LVIII.2) repeats the first definition; that is the "standard" *angula* of classical India — there are indeed variations in regional traditions of iconometry, but they need not detain us here. Most scholars from J. F. Fleet down took the angula to be "roughly equating ... ¾th of an inch" (Chattopadhyaya 1986: 231), that is, 1.9 cm. Shukla (1976: 19), Shastri (1996: 327) or Bag (1997: 667), to quote just a few, endorsed this approximate value.

Mainkar (1984: 147) traced the "development of length and area measures in India" and narrowed the value of the *angula* to 17.78 mm. He was perhaps the first to suggest that 10 times the Lothal unit, i.e. 17.7 mm, was thus almost identical to the traditional *angula*. Let us build on Mainkar's suggestion and define a "Lothal *angula*" as A_L being ten times the Lothal unit. With this definition, we can now write **D = 108** $\mathbf{A_L}$: Dholavira's unit is equal to 108 Lothal *angulas*. An organic relationship between the Dholavira unit and the Lothal scale is not surprising, considering the geographical proximity of the two cities.

The above result is arresting, since the concept of "108 *angulas*" is well attested in classical India. For instance, one of the systems of units described in Kautilya's *Arthashastra* (2.20.19) fits very well in the Dholavirian scheme: "108 *angulas* make a *dhanus* (meaning a bow), a measure [used] for roads and city-walls...." (Kangle 1986: 139).

We should note that S. R. Rao provides no margin of error in the reading of the Lothal scale; our above approximation of 0.4% corresponds to less than 0.2 mm from the 46 mm read on the scale, and we can safely assume that such a minute difference would have been rounded off. With our unit D = 1.904 m firmly established by Dholavira's geometry and structures in other settlements, we can propose a more precise value for the Lothal *angula* A_L: 190.4 / 108 = **1.763 cm** (instead of 1.77 cm).

More on Subunits

The Harappan brick provides us with a serendipitous confirmation of the Lothal *angula*. In the Mature phase (and occasionally in the Early phase), most bricks follow ratios of 1 : 2 : 4 in terms of height-width-length; among several different sizes in this ratio, one dominates by far: 7 x 14 x 28 cm, measured and averaged over numerous samples (Kenoyer 1998: 57 and Jansen quoted by Rottländer 1983: 202); the first dimension, 7 cm, is almost exactly 4 Lothal *angulas* (the difference being just 0.5 mm or 0.7%). This is an important confirmation of the *angula*, independent of the Lothal scale. So the humble brick's dimensions can be elegantly expressed as **4 x 8 x 16** $\mathbf{A_L}$.

Between the *angula* and the *dhanus*, there must have been several important subunits. Across the ancient world, units for the digit, the palm, the span, the foot and the cubit were common, together with multiple variations. The Egyptian royal cubit, for instance, had no fewer than six subunits between itself (52.4 cm) and the digit (1.87 cm), its 28th part, in multiples of 4, 5, 12, 14, 16, 24 digits. Below are a few case studies of the use of possible multiples of the Lothal *angula*, or subunits of the *dhanus*.

A useful analysis derives from 13 long dimensions of Mohenjo-daro houses; they were measured by R.C.A. Rottländer from precise plans, not on the ground (Rottländer 1983: 201). Let us now express those dimensions in terms of *dhanus* and *angulas*. For the purpose, however, let us first notice that one of the dimensions, 380.2 cm, is twice 190.1 cm, which is virtually identical to our *dhanus* D = 190.4 cm; but since, according to Rottländer, this dimension appears "five times as the inside diameter of inner rooms of houses," the difference, however small (0.2%), may be significant. Till a discussion further below, let us adopt here a "Mohenjo-daro *dhanus*" or $\mathbf{D_M}$ **= 190.1 cm**, with a corresponding "Mohenjo-daro *angula*" or A_M equal to 190.1 / 108 = **1.76 cm. Table 4** translates Rottländer's measurements into those two units for further study (because dimensions are long ones, all results are within 0.1%).

Table 4: Rottländer's measurements and expressions in the proposed scheme of dhanus and angulas.

No.	**Dimension at Mohenjo-daro** (in cm)	**Expression in terms of** $\mathbf{D_M}$ **&** $\mathbf{A_M}$
1	345.2	$1\ D_M\ 88\ A_M$
2	369.9	$1\ D_M\ 102\ A_M$
3	380.2	$2\ D_M$
4	506.8	$2\ D_M\ 72\ A_M$
5	567.2	$3\ D_M$
6	647.6	$3\ D_M\ 44\ A_M$
7	682.2	$3\ D_M\ 64\ A_M$
8	702.7	$3\ D_M\ 75\ A_M$
9	796.2	$4\ D_M\ 20\ A_M$
10	845.2	$4\ D_M\ 48\ A_M$
11	873.2	$4\ D_M\ 64\ A_M$
12	1106.1	$5\ D_M\ 88\ A_M$
13	1440.2	$7\ D_M\ 62\ A_M$

The third column suggests the following conclusions:

1) Nos. 3 and 5 are perfect multiples of D_M.
2) No. 9, with a remainder of 20 A_M, suggests twice **10 A_M**.
3) No. 8, with a remainder of 75 A_M, suggests five times **15 A_M**.
4) Nos. 7, 10 and 11, which have a remainder of 48 or 64 A_M, suggest a multiple of **16 A_M**. This subunit is also the length of the most common brick, as we saw.
5) No. 4, with a remainder of 72 A_M, suggests twice **36 A_M** (this subunit of the *dhanus* makes sense, since the latter is 108 *angulas* = 36 x 3, but it could also be formed out of a subunit of **12 A_M**).
6) With the above proposed subunits, No. 1's and No. 12's remainder of 88 A_M can be expressed as 36 x 2 + 16 A_M. No. 2's remainder of 102 A_M is 36 x 2 + 15 x 2 A_M. and No. 13's remainder of 62 A_M is 15 x 2 + 16 x 2 A_M.
7) Finally, No. 6's remainder of 44 A_M can be explained with an additional subunit of **8 A_M** as 36 + 8 A_M. This new subunit is not unnatural, since it is the width of the most common brick.

It should be stressed that the above subunits are, at this stage, tentative suggestions based on a few measurements; many precise dimensions, especially smaller ones (in the range of 50-200 cm) would be needed to confirm the proposed system, and add to or subtract from it. (A discussion of Rottländer's conclusions drawn from the above 13 measurements is beyond the scope of this paper; let it simply be said here that they are based on a few arbitrary choices and do not appear to result in an internally consistent system.)

For the present, let us examine a few such smaller dimensions suggestive of specific subunits:

1. Kalibangan's streets have widths in an arithmetic progression: 1.8, 3.6, 5.4 and 7.2 m (Lal 1997: 127). Such widths are found at other sites: Banawali's bigger streets measure 5.4 m (Lal 1997: 127). Moreover, 1.8 m occurs in other contexts: it is the height of the corbelled drain forming the outlet of Mohenjo-daro's Great Bath (Jansen 1988: 136). This dimension is nearly 102 A_M (0.3%), which is the same as the remainder in dimension No. 2 of Table 4.
2. Mackay reports at Mohenjo-daro a lane and a doorway having both a width of 1.42 m (Mackay 1938: 9, 11). This dimension, equal to 81 A_M (0.4%), is interesting because it is exactly 3/4 of 108 A_M or 1 D_M, i.e. three quarters of a *dhanus*. This suggest that one quarter, **27 A_M**, could have been another subunit.
3. Mainkar noticed a connection between the three known Harappan scales: Mohenjo-daro's (a broken piece of shell with divisions of 6.706 mm), Harappa's (a piece of bronze rod with divisions of 9.34 mm), and Lothal's ivory scale (Mainkar 1984: 146). He suggested that **10 Mohenjo-daro units + 15 Lothal units = 10 Harappa units**; Mainkar's margin of error was too high (0.8%), because of his wrong value for the Lothal unit. With our value of A_M (1.76 cm), this works out to 67.06 + 26.4 = 93.46 mm, correct to less than 0.1%. This remarkably low margin of error makes an accidental relationship between the three scales extremely unlikely. Mathematically, it can also be expressed as: **1 Harappa unit is equal to 1 Mohenjo-daro unit plus 3/2 or 1.5 times the Lothal unit**. The advantage of the first expression is that it again brings out subunits in multiples of 10 and 15.

Adding 4 *angulas*, the height of the common brick, the above dimensions suggest the play of 7 subunits of the *dhanus*: 4, 8, 10, 15, 16, 27 and 36 *angulas*. The first, 4 A_M or 7.0 cm, and the last, 36 A_M or 63.4 cm, are respectively comparable to the palm unit and the "double foot" of other ancient cultures (Rottländer 1983: 205). If Harappan builders did see it as a "double foot," then they may have used its half, 18 *angulas* or 31.7 cm, as a "foot," which would add another subunit to the above list.

That is as far as we can go regarding subunits until a number of precise dimensions can be examined.

Which *Dhanus-Angula* pair?

We derived one pair of units from Lothal and Dholavira (1.763 / 190.4 cm), and another from Mohenjo-daro (1.76 / 190.1 cm). Although the two pairs are almost identical (differing by less than 0.2%), is there any ground to prefer one to the other? Returning to Mainkar's relationship between the three Harappan units, the margin of error rises to 0.11% if we use the Lothal *angula*. Similarly, if we recalculate margins of error between theoretical and real values in the case of a few fairly precise dimensions examined earlier, we find that the Mohenjo-daro pair comes closer than the Dholavira pair in three cases out of four, as shown in Table 5

Finally, if we revisit Table 3 of Dholavira's dimensions and apply to it the Mohenjo-daro rather than the Lothal pair, we find all margins of error reduced by 0.2%; four margins (concerning the lower town's and the bailey's dimensions) now become negative: we have 7 positive margins and 5 negative ones, instead of a single negative margin earlier. Statistically speaking, this is a better distribution.

All these considerations suggest that the Mohenjo-daro pair gives consistently closer results. We may therefore remove subscripts "L" and "M" and adopt, subject to further, more detailed studies, a general Harappan *angula* **A = 1.76 cm**, and a general *dhanus* **D = 190.1 cm** (which may be rounded off to **1.9 m** when dimensions are not extremely precise).

Continuity of the Dholavira Scheme of Ratios and Units

The scheme of ratio and units found at Dholavira finds unmistakable echoes in historical times.

Earlier (Danino, in press), it was recalled how the *Arthashastra*, the *Natyashastra* and Varahamihira's *Brihat Samhita* used various multiples of the *angula*. For instance, the *danda* ("staff") could be defined as 96, 108 or more *angulas*; classical treatises of Hindu architecture such as the *Manasara* recommend measurements with a rod of 108 *angulas*; and iconometry prescribes heights of 84, 86, 108 or 120 *angulas* for statues of deities, although "many [early texts] concentrate on the description of an image of 108 *angulas* in length" (Nardi 2006: 260).

The origin of the concept behind the sacred number 108 is probably multiple. It could be simply based on the human body: 108 *angulas* (1.9 m) is the height of a tall man, as specifically mentioned by Varahamihira in his *Brihat Samhita* (68.105) (Bhat 1981: 642). Also if, as our above analysis suggests, 27 A and 36 A were standard subunits, the least common multiple of those two numbers happens to be 108 (= 27 x 4 or 36 x 3). From a different perspective, simple but compelling astronomical considerations behind 108 have been demonstrated by Subhash Kak (2000: 101-02, 124).

Dholavira's ratios must have been perceived as specially auspicious, otherwise every enclosure might as well have been square. Some of those ratios are still in use in various traditions of Vastu Shilpa. In the sixth century A.D., Varahamihira, for instance, wrote in his *Brihat Samhita* (53.4 and 5): "The length of a king's palace is greater than the breadth by a quarter.... The length of the house of a commander-in-chief exceeds the width by a sixth...." (Bhat 1981: 451-52). These two ratios, 1 + 1/4 and 1 + 1/6, are identical to 5/4 and 7/6 — very precisely Dholavira's ratios (5/4 for the "castle" and the lower town, 7/6 for the middle town). Such a perfect double match is beyond the realm of coincidence.

A recent work by Mohan Pant and Shuji Funo (2005) compared the grid dimensions of building clusters and quarter blocks of three cities: Mohenjo-daro, Sirkap (Taxila, early historical), and Thimi (in Kathmandu Valley, a contemporary town of historical origins). The results are striking: the authors, after a careful superimpositions of grids on published plans of all three cities (their own in the case of Thimi), find that block dimensions measure 9.6 m, 19.2 m (= 9.6 m x 2), or multiples of such dimensions. This, they argue, evokes the *Arthashastra*'s unit called *rajju*, equal to 10 *dandas*. As regards the *danda*, which has four possible traditional values, the authors choose that of 108 *angulas* as prescribed in the *Arthashastra* (2.20.18-19); it is the same passage which this paper quoted earlier to define the *dhanus*, and the *danda* is mentioned in it as another name of the *dhanus*: for our purpose, the two terms are identical. Pant and Funo conclude from their grids that the unit of length common to the planning of those three cities of very different epochs was the *rajju* = 19.2 m, based on the *danda* = 1.92 m.

If Pant's and Funo's work (of which this author was unaware in his first studies of Dholavira's geometry) finds acceptance among scholars well versed in Harappan and historical town-planning, it will have two important implications. First, it will provide a dramatic confirmation of the scheme worked out for Dholavira, since, proceeding from completely independent methods and different structures (blocks and clusters), it yields a unit of 1.92 m consisting of 108 *angulas* (the difference with our value of 1.901 m is 2 cm or 1%, probably well within the margin of error of the two authors' grid-based method). Secondly, it will lend support to our own conclusion that such concepts survived the collapse of Harappan urbanism, and that Kautilya's canons of urbanism had Harappan roots. Is it so surprising when we already know that the weight system, metallurgical, agricultural and craft techniques did live on, apart from numerous religious symbols and practices? (Danino 2003)

Indeed, preliminary surveys by this author of dimensions at historical sites have been rewarded by a high proportion of multiples of Dholavira's *dhanus*. However, this line demands further research before it can be presented systematically.

In the meantime, having established a basic continuity of linear measures between India's two urbanizations, we may ask whether the *angula-dhanus* system, as well as some important ratios found in the Mature phase, are in evidence at Late Harappan sites. Unfortunately, a full answer to this question may have to wait, as very few sites of that phase have so far been subjected to substantial horizontal excavations.

Archaeological Considerations

One might object that if Harappans made such a rigorous and systematic use of units of length, we should expect to find many more scales in their cities and towns. But we already have four Harappan scales (from Mohenjo-daro, Harappa, Lothal and Kalibangan) against none at all anywhere from the historical period, when units of lengths were certainly in common use as the *Arthashastra* and later texts testify; the number of extant scales is thus not a reliable indicator. Also, scales made of terracotta, such as Kalibangan's, were necessarily fragile and smaller fragments could have escaped notice. Finally, and this would have applied to historical times too, linear measures were conceivably produced for daily use in the form of sticks or even knotted ropes or strings copied from one master standard of length. In fact, the making of measuring rods from the wood of specific trees and the weaving of measuring ropes from specific fibres or types of grass form an integral part of traditional iconometry and architecture in India, especially in the South (Ganapathi Sthapati and Ananth 2002: 238-39).

Indeed, the very word *rajju* means "rope." If we try to picture the physical act of laying out a city like Dholavira, with dimensions running into hundreds of metres, the combined use of the *rajju* and the *dhanus* makes eminent sense: with one rope carefully measured out as a *rajju* (19.01 m) and another measured out as a *dhanus* (1.901 m), the whole city's layout can be quickly and securely translated on the ground: taking the case of lengths alone, that of the inner "castle" will be 6 ropes, of the outer "castle" 8 ropes, of the ceremonial ground 15 ropes, of the middle town 18 ropes, and of the entire city 40½ ropes. It would be hard to conceive of a more felicitous scheme.

Another objection might be in the form of this question: If Mohenjo-daro's and Harappa's units are related to Lothal's, where and how do the former two come into play? Indeed, for decades, archaeologists and other scholars have referred to an "Indus inch" (defined as 5 times the Mohenjo-daro "unit" of 6.7056 mm, therefore 3.3528 cm) and an "Indus foot" 10 times longer, but those hypothetical units, based on the Mohenjo-daro scale alone, never resulted in any significant analysis of available dimensions, as Mackay readily conceded: "Few of the widths of the doorways are actual multiples of the unit marked on the scale that has been found [at Mohenjo-daro]" (Mackay 1938: 405).

By comparison, the *dhanus-angula* system appears to work better. Apart from the many examples provided in earlier sections, a study of frequent dimensions of doorways at Mohenjo-daro is eloquent. Table 6 translates Mackay's six most common dimensions (1938: 167) into centimetres and expresses them in terms of the nearest "Indus inch" and the nearest *angula*.

Margins of error are slightly smaller with the *dhanus-angula* system, but more importantly, it yields multiples that are far more natural (all of them as even numbers) and wholly compatible with the system of subunits tentatively outlined above, while, as Mackay observed, the multiples of Indus inches cannot be combined into a coherent system. Working from a different angle, Rottländer doubted whether Mohenjo-daro's shell scale was a ruler at all: "There is a high chance that it was part of an ornament or finger-board of a stringed instrument" (1983: 202). It is clearly necessary to revisit the whole field of Harappan metrology from a fresh perspective.

Table 6: Comparison of widths of doorways at Mohenjo-daro, expressed in two different systems of units

Width of doorway	In *Indus inches*	Margin of error (%)	In *dhanus-angulas*	Margin of error (%)
71.1	21	1	40 A	1
101.6	30	1	58 A	0.5
111.8	33	1	64 A	0.8
147.3	44	0.1	84 A	0.4
180.3	54	0.4	102 A	0.5
243.8	73	0.4	1 D 30 A	0.4

In this respect, R. Balasubramaniam (in press), recently submitting Kalibangan's "crude terracotta scale" to careful scrutiny, established that it is based on a unit of 1.75 cm. This is almost identical to our *angula* of 1.76 cm; given that the scale would have slightly contracted during the firing process, the difference of one tenth of a millimetre (0.6%) actually points to a high precision. The Kalibangan scale therefore provides a powerful confirmation of the Harappan *angula*.

Harappan and Classical Concepts

On a cultural level, the presence of carefully proportioned fortifications as at Dholavira might be as much a specific cultural trait as pyramids are to Egypt or ziggurats to Mesopotamia. Here, instead of erecting colossal buildings, enormous energy was spent on defining spaces: the space of the rulers and administrators (the acropolis) and the spaces for other classes of citizens. Demarcating was a vital need not for defence, but for self-definition.

But there may also be deeper motives at work. Ratios and units apart, we can discern a few important principles underlying Dholavira's fascinating harmony, in an almost Pythagorean sense of the term.

In a recent study of the origins of geometry in various civilizations, Olivier Keller, turning to the *Sulbasutras*, is struck by "the very frequent addition, in Vedic numerology, of one unit. ... The addition of a unit is a way to envelop the various parts in a unity; thus 7 can be the result of the addition of the four cardinal directions, above, below, *and space itself.* Or again 21, which is 3 times 7, can also represent man because of his 20 fingers *and his body...* We can discern, as in the analogies related to the parts of the [Vedic] altars, the profound thought of a totality reflecting itself in every part, and conversely of the union of various parts in a totality" (Keller 2006: 138, italics in the original). Similarly, when Varahamihira specifies the length of a king's palace, rather than express it as 5/4 or 1.25 times the width, he asks us to add a quarter to the width, that is, to the unit: 1 + 1/4. Adding one more unit, we get 1 + 1 + 1/4 = 9/4. We can now understand that these two fundamental ratios of Dholavira emerge from the same principle of *addition of a unit*; 9 : 4 is, in reality, nothing but 5 : 4 plus one unit.

This addition to the unit of a fraction of itself can also be seen as a process of *expansion*, of *auspicious increase* symbolizing or inviting prosperity. The *Manasara*, a treatise of Hindu architecture, applies this process when it specifies (35.18-20) that "the length of the mansion [to be built] should be ascertained by commencing with its breadth, or increasing it by one-fourth, one-half, three-fourth, or making it twice, or greater than twice by one-fourth, one-half or three-fourths, or making it three times" (Acharya 1934/1994: 374). The outcome is a series of auspicious ratios: 5/4, 3/2, 7/4, 2/1, 9/4, 5/2, 11/4, 3/1. It is significant that we have found all but one ratios (11/4) at Dholavira or other Harappan settlements, and reasonable to assume that the concept behind such ratios is the same in Harappan and in historical times.

Also found at Dholavira is the principle of *recursion*, or repetition of a motif. In our case, the ratio 9 : 4, between the lengths of the "castle" and of the middle town, is repeated between the lengths of the middle and the lower towns. This principle is visible in classical architecture; in temples, for instance, *shikharas* of increasing height build up towards the towering last one. This is another way of repeating the initial unity and grow from it.

The Harappans' use of a *decimal system* is already evidenced, as is well known, in the weight system. (We must stress that contrary to a common misconception, an *empirical* decimal system in no way requires numerals with a decimal place-value notation and the zero: that development occurred in India in the fourth or fifth century AD.) The Harappan decimal system is conspicuous at Dholavira: in the Lothal *angula* equal to 10 units of the Lothal scale, and, at the other end of our range, in Pant's and Funo's *rajju* equal to 10 *dandas* (*dhanus*).

As an aside, we can now express the theoretical width of the castle's eastern and western fortifications as 10 *dhanus* = 1 *rajju*. Is it not to be marvelled at that members of the elite that occupied this high point of the city chose to embed this concept of **one unit** in their massive walls? Had they merely wished to have effective defences, a few metres would have sufficed, even if inner rooms had to be integrated; a width of up to 19 m might appear as a mindless waste of material and labour, but it is a strong clue to an underlying cultural or sacred concept.

The common thread connecting those principles was anticipated by astrophysicist J. McKim Malville, who saw in Dholavira's features "the apparent intent ... to interweave, by means of geometry, the microcosm and the macrocosm" (Malville and Gujral 2000: 3). To the ancient mind, the concept of sacred space is inseparable from the practice of town-planning and architecture.

There would be more to say on Dholavirian numbers, especially number 3 which is the key to the whole city, and its omnipresent square 9, but this must wait till a body of evidence can be built from other Harappan sites. In the meantime, we have covered enough material to strengthen Jim Shaffer's thesis of a strong connection between Harappan urbanism and the urbanism of historical times, in which he finds "a unique cultural tradition traceable for millennia" (Shaffer 1993: 54), or Dilip Chakrabarti's recent observation: "The ideals of ancient Indian town planning seem to run deep through the concepts embedded in the Harappan cities like Mohenjodaro and Dholavira" (Chakrabarti 2006: 166).

Acknowledgements

This study would have been impossible without the precise measurements of Dholavira published by Dr. R.S. Bisht; his observations on a few crucial ratios also acted as a catalyst. I am grateful to Prof. B.B. Lal and the late Dr. S.P. Gupta for their kind and constant encouragements, and to Dr. V.N. Misra for kindly inviting me to contribute this paper to Man and Environment; also to Prof. Subhash Kak for his valuable comments on earlier papers, in particular regarding the important concept of recursion, and to Prof. R. Balasubramaniam for his sharing of the data on the Kalibangan scale and his warm encouragement.

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Anthropological Studies on Human Skeletons from the PGW site of Abhaipur (District Pilibhit), U.P.

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Abstract

This report comprises findings of anthropological investigations carried out on skeletal remains of two individuals, an adult and a child, uncovered from the PGW level at the site of Abhaipur (U.P.). The Abhaipur human skeletal remains are important in many ways. The excellent preservation of the adult skeleton provides a rare opportunity for an in depth anthropological study. Several uncommon non-metric features have been noticed. Some of them are being reported for the first time for any Indian protohistoric skeletal specimen. Degenerative pathologies involving joint and vertebral disorders and neoplastic lesions have also been noticed. The young individual exhibits evidence of metabolic disorders. A detailed morphometric account of these specimens is discussed in this paper.

The Archaeological Context

The site of Abhaipur (28° 18 N'; 79° 45' E), District Pilibhit (U.P.), is located 35 km east of Bareilly (Fig. 1). Archaeological excavations were undertaken at the site by the Department of Ancient History and Culture, M.J.P. Rohilkhand University, Bareilly under the leadership of the second and third authors for three field seasons, 2004-05-06 (Arora *et al.* 2002; Misra and Arora 2006).

The site has yielded evidence of multicultural habitation: (a) ochre-coloured ware (OCW) culture; (b) Black-and-Red ware (BRW) culture; (c) Painted Grey Ware (PGW) culture; and, (d) Northern Black Polished Ware (NBP) culture. The most important finds of the PGW culture at Abhaipur comprises two human burials; one of an adult and the other of a child.

The adult burial

This was an extended burial aligned in slightly NE-SW direction. The body (length 170 cm) was interred in a shallow, narrow pit dug into the floor of a house. This was inferred owing to the slightly curved posture of the skeleton with the waist bent down, and head and legs being slightly elevated. Lying on its back, the skeleton was found slightly tilted towards the right, and the head was placed laterally facing right. The legs were outstretched with the right ankle over the left. The position of legs indicates that they were tied at the ankles. The left arm was folded at the elbow and was placed on the waist with the fingers hanging down. The right arm was folded in a peculiar manner at the elbow with the palm placed against the chin (Fig. 2).

A convex-sided bowl of Painted Grey Ware was found near the waist of the skeleton. No other grave goods were found.

The child burial

An extended child burial was found close to the adult burial, lying perfectly aligned, with the head towards the north. The burial pit was dug into the floor. The skeleton was placed laterally, lying on its right hand. The legs were in a flexed position. The right hand was placed on the waist. The ankles were totally destroyed by a thick tree root, which was found in a decomposed condition. No grave goods were found (Fig. 3). The extant length of the skeleton was about 71 cm.

The discovery of two human skeletons from Bhagawanpura (District Kurukshetra, Haryana) needs to be mentioned here. This site, lying on the bank of river Saraswati, was excavated in the year 1975-76, and two cultural periods were identified, *viz.* Late Harappan and Late Harappa-PGW, with no noticeable cultural break. The interesting feature is the manner in which these skeletons were discovered. As at Abhaipur, the Bhagawanpura skeletons also belonged to an adult (male, 35 years old, height: 144 cm), and a child (female, 8-10 years old, height: 104 cm) (Joshi 1993:149-183). Both skeletons were inhumed in the habitation area in a N-S direction, the head facing north. Lying laterally on their

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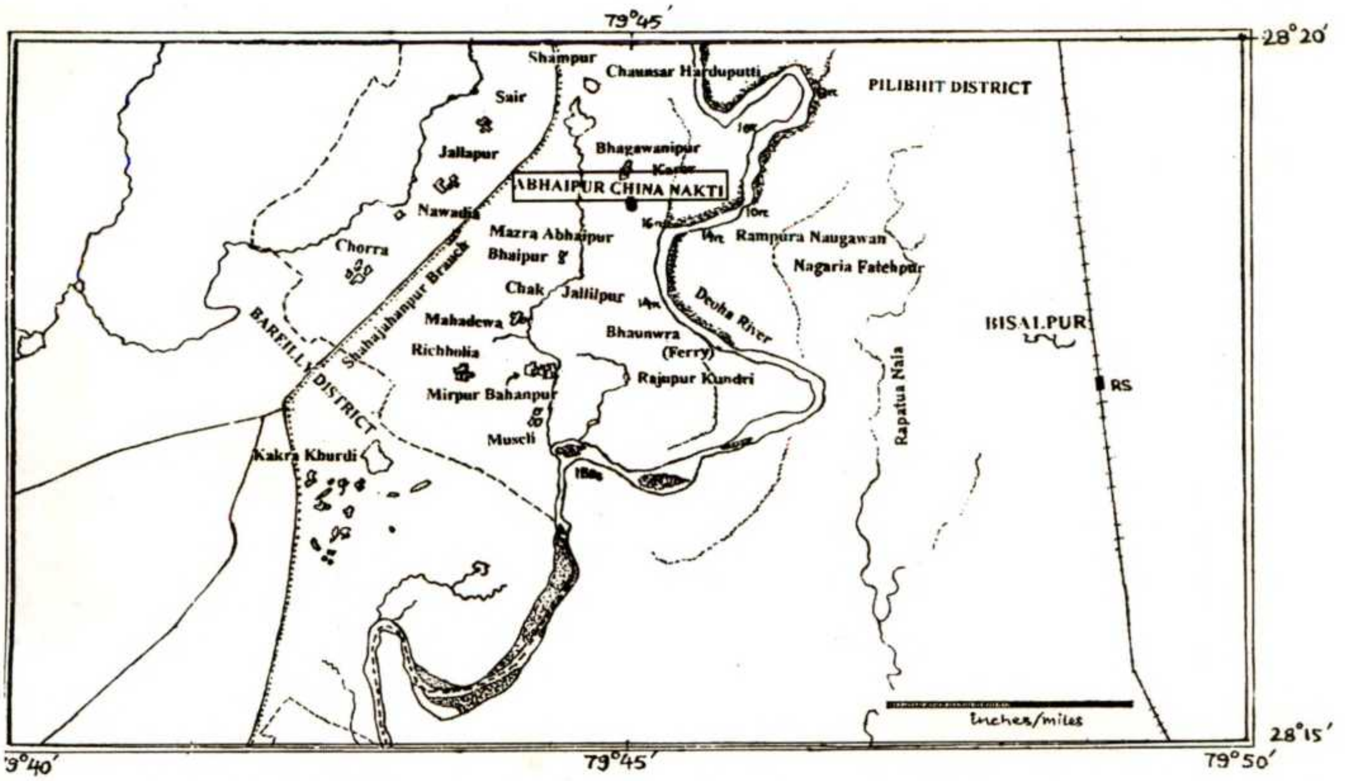

Fig. 1: Location map showing Abhaipur

right sides, the skeletons faced west, identical to those at Abhaipur.

The adult was buried inside a pit. No pit outline was found in case of that at the child burial, which is again similar to that at Abhaipur. A broken bowl of Painted Grey Ware was found from the adult burial of Abhaipur, while the child burial was devoid of offerings.

Evidence from Abhaipur and Bhaganwanpura strongly indicates the prevalence of common burial customs or mortuary practices during the Painted Grey Ware culture, hitherto unknown in Indian archaeology. The burials were dug in the habitation area as noted at both sites with little to no offerings.

Realizing the importance of the Abhaipur burials, the second author removed the skeletons along with the surrounding soil. Dilute water-soluble adhesive (Fevicol) was used to harden the soil. The entire procedure of exposing the bones, preparing field documentation, and lifting the skeletons was completed within 15 days. During this time, adequate measures were taken to protect the bones from direct sunlight and moisture. The exercise proved very useful in minimizing post-mortem weathering changes, and all bones could be recovered for further studies.

The anthropological studies on the osseous remains collected from the burial were undertaken by the first author under the supervision of the fourth author. The studies were conducted in the 2nd week of November 2006 at Bareilly. The findings of this study are the subject matter of the present report.

Material (Preservation status) and methodology

The adult skeleton is one of the best-preserved skeletons in the Indian protohistoric context. However, the sub-adult skeleton, lying close to the adult burial, was very poorly preserved, and only a few long bones could be traced. The skull was badly damaged. A few teeth could be collected. Standard and universally accepted methodologies (Table 1) have been followed for age-sex identification and morphometric study.

A. Adult Individual

The completeness of this adult male specimen provides a rare opportunity for thorough morphometric inspection.

Cranial elements

The cranium is complete, except for some damage to the right lateral aspect of the frontal bone (Figs. 4 to 7; Table 2). In *norma verticalis* perspective the skull looks ovoid in shape. The skull is long (maximum cranial length 185 mm, breadth 128 mm), falling in hyperdolichocranial category with a cranial index of 69.19. Robusticity of the individual is seen in the frontal bone in the form of well developed glabella and supra-orbital ridges. The temporal lines too are very well marked. The forehead is straight and

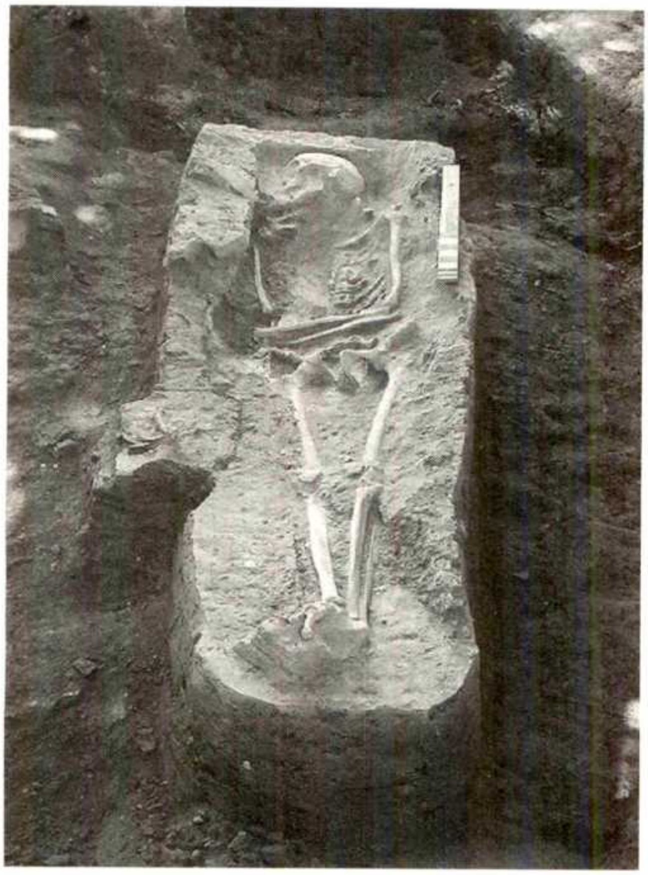

Fig. 2: Adult burial

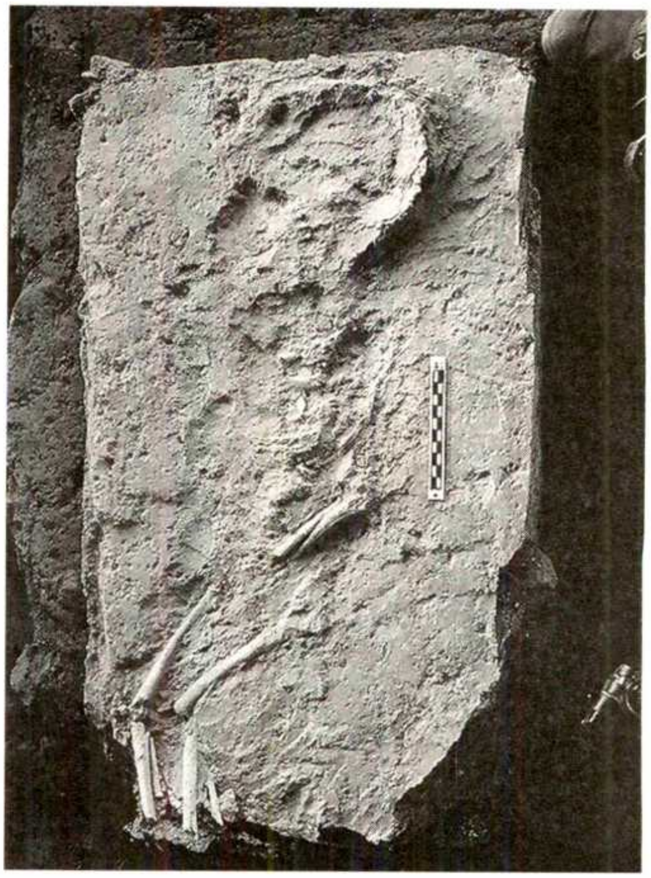

Fig. 3: Child burial

Table 1: Methods and guidelines used in this study

Method	Reference
Sex and age determination	Brothwell (1981), Olivier (1969), Olivier (1969), Stewart (1979),
Morphological assessment	Ubelaker and Buikstra (1994) Ubelaker and Buikstra (1994)
Metric analysis	Martin-Saller (1957)
Stature estimation	Trotter (1970)
Odontometry	Moorrees (1957a, 1957b), Wolpoff (1971), Potter *et al.* (1981), Dahlberg (1963), Selmer-Olsen (1949)
Dental morphology	Turner II. *et al.* (1991)
Pathology	Larsen (1997), Ortner and Putschar (1981), Roberts and Manchester (1995), Lukacs (1989)

sloping backwards from the metopic region. The cranial contour is prominent, and though the skull is moderately high (basion bregma height 125 mm) the vertical index is only 67.57 (chamaecranial category). The right infra-orbital border is blunt. The right side supra-orbital foramen is in the form of a notch, without complete foramen.

The parietal tubera are moderately developed. Mastoids are well developed. The styloid processes are also very prominent. The nuchal region of the occipital is pronounced. The inion point is pronounced and seen as plate like projection.

The two processes on sphenoid, pterygoid hamulus, are of excessively large size. Since the feature is expressed symmetrically on both sides, it appears to be morphological, and not pathological. The cranial capacity (using basion-bregma height) is 1311.96 cc.

In profile, the face, nasal and the alveolar region are straight, orthognathus. Orbits are medium sized (mesochonch), and square shaped. The nose is narrow (nasal index 44.44, leptorrhinae). The palate is broad (palatal index 105.41, brachystaphylin), and high (palatal height index 46.15, hypsistaphylin) (Fig. 8). The mandible is equally robust. The gonial region is moderately everted. The ascending rami are broad. The chin is squarish (Fig. 9). The hyoid bone also is present and undamaged. This bone is rarely preserved in archaeological specimens.

Table 2: Craniometric data: Abhaipur adult

Measurement	Value (mm)
Maximum cranial length (1)	185
Glabella inion length (2)	177
Nasion inion length (2a)	172
Glabella lambda length (3)	174
Nasion basion length (5)	109
Nasion opisthion length (5-1)	132
Opisthion basion length (7)	38
Maximum cranial breadth (8)	128
Minimum frontal breadth (9)	102
Maximum frontal breadth (10)	117
Bi-auricular breadth (11)	116
Greatest occipital breadth (12)	106
Bi-mastoid breadth (13)	105
Breadth of foramen magnum (16)	33
Basion-bregma height (17)	125
Basion vertex height, total height of skull (17-2)	126
Auriculo bregmatic height (20)	97
Porion (auriculo) vertex height(21)	98
Calvarial height (22)	92
Lambda calvarial height (22b)	69
Frontal perpendicular height [22e]	30
Parietal perpendicular height [22f]	22
Occipital perpendicular height [22g]	24
Horizontal circumference of skull (23)	515
Transverse arc (24b)	320
Longitudinal arc (25)	382
Frontal arc (26)	110
Parietal arc (27)	109
Occipital arc (28)	100
Frontal chord (29)	130
Parietal chord (30)	122
Occipital chord (31)	130
Facial length, facial depth (40)	91
Lower facial length, inferior facial depth (42)	103
Outer bi-orbital breadth, upper facial breadth (43)	113
Inner bi-orbital breadth (43-1)	105
Bi-orbital breadth (44)	103
Bi-zygomatic breadth (45)	138
Breadth of upper jaw (46)	99
Morphological facial height (47)	125
Upper facial height, morphological	

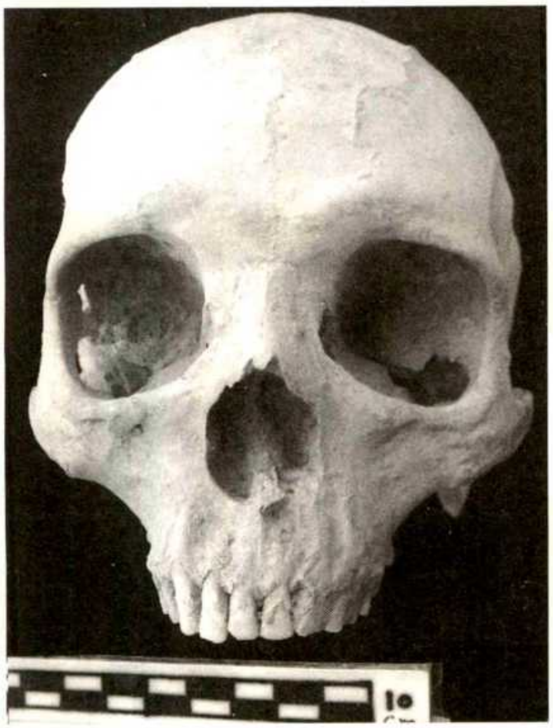

Fig. 4: Norma frontalis

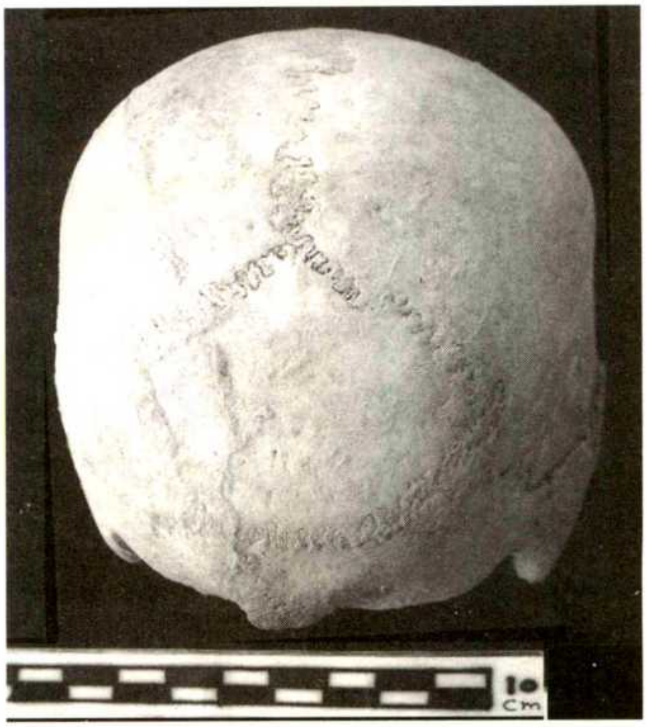

Fig. 6: Norma occipitalis

Measurement	Value (mm)
superior facial ht. (48)	75
Breadth of nasal root (49)	14
Anterior inter-orbital breadth (50)	29
Orbital breadth (51)	R:45, L: 4
Orbital height (52)	R:37, L: 36
Nasal breadth (54)	24
Nasal height (55)	54
Length of Nasal bones (56)	27
Maxillo-alveolar length, length of upper jaw (60)	48
Maxillo-alveolar breadth, breadth of upper jaw (61)	54
Sub-nasal height (48-1)	16
Palatal length (62)	37
Palatal breadth (63)	39
Palatal height (64)	18
External palatal arc (80)	140
Molar teeth row length (80-3)	R: 29, L: 30
Premolar teeth row length [80-3a]	R: 13, L: 12
Bi-condylar breadth (65)	113
Bi-coronoid breadth (65-1)	103
Bi-gonial breadth (66)	86
Bi-mental breadth, anterior breadth (67)	45
Length of lower jaw (68)	81
Condylo-symphyseal length (68-1)	R: 123, L: 123
Chin height, symphyseal height (69)	29
Condylar height, height of ascending ramus (70)	R: 67, L: 66

Measurement	Value (mm)
Height of coronoid (70-1)	R: 64, L: 64
Ascending ramus minimum breadth (71)	R: 33, L: 33
Ascending ramus maximum breadth (71-1)	R: 42, L: 41
Condylo-coronoid breadth	R: 35, L: 35
External mandibular arc (80a)	197
Molar teeth row length [80-1a]	R: 32, L: 32
Premolar teeth row length [80-b]	R: 11, L: 11
Total profile angle, facial profile angle (72) (Orthognathous)	88
Nasal profile angle (73) (Orthognathous)	87
Alveolar profile angle (74) (Orthognathous)	85
Profile angle of nasal root (75)	67
Metopic angle, profile angle of forehead (32)	86
Lambda-opisthion angle (33)	135
Calvarial base angle (37)	9
Glabella-inion angle (32a)	11
Nasion-basion angle (33-l)	152
Lambda-inion angle	87
Bregma angle of Schwalbe (32-1)	19
Lambda angle of Schwalbe	79
Angles of superior facial triangle N - ba - pr	43

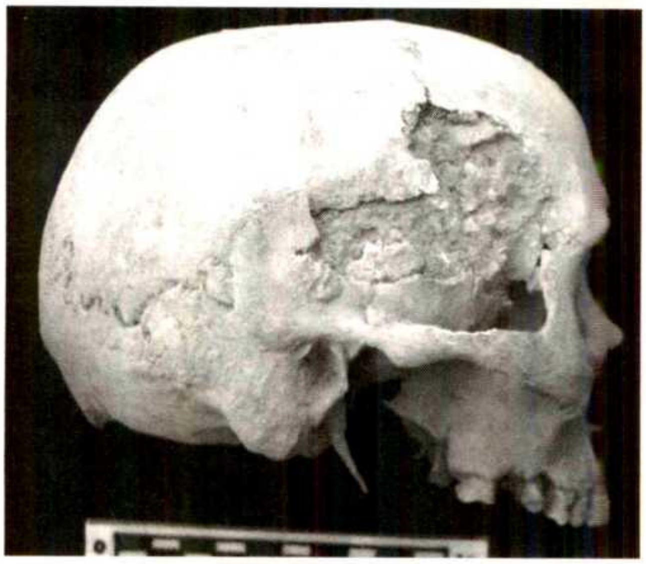

Fig. 5: Norma lataralis: R side

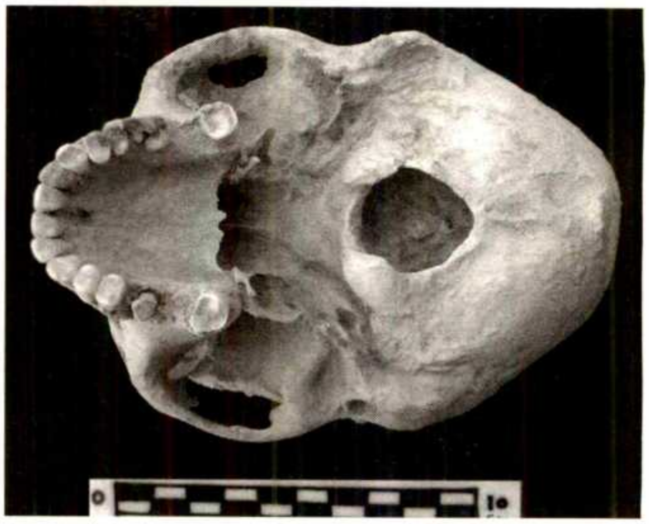

Fig. 7: Norma basilaris

Measurement	Value (mm)
Ba - pr - n	70
Pr – n - ba	67
Angles of cranial quadrilateral	
L – ba - n	116
Ba- n - b	80
N - b - l	102
B – l - ba	62
Mandibular angle, gonial angle (79)	R: 108, L: 108
Chin angle (Oetteking 1945)	77
Mento-basal angle of mandible (Oetteking 1945)	81
Anteriobasal angle of mandible (Oetteking 1945)	93
Basal angle of mandible (Oetteking 1945)	3
Posteriobasal angle of mandible (Oetteking 1945)	113
Ramus angle of mandible (Oetteking 1945)	64
Condylo-coronoid angle of mandible (Oetteking 1945)	5
Cranial capacity (Lee-Pearson 1901) (38)	1311.96
Cranial index (I 1) (Hyperdolichocranial)	69.19
Length-height cranial index, vertical index (I 2) (Chamaecranial)	67.57
Breadth-height cranial index, trans. Vertical index (I 3) (Metriocranial)	97.66
Auriculo-vertical index (I 4) (Chamaecranial)	52.43
Calvarial height-breadth index (I 6)	71.88
Hauschild's circumference height index (I 9)	24.27
Sagittal arc index (I 10)	45.03
Transverse frontal index (I 12)	87.18
Transverse fronto breadth index, frontal index (I 13) (Eurymetopic)	79.69
Sagittal frontal index (I 22) (Orthometopic/round)	118.18
Sagittal parietal index (I 24)	111.93
Sagittal occipital index (I 25)	130.00
Foramen magnum index (I 33)	86.84 (Broad)
Skull modulus (I 37)	146.00
Total facial index (I 38) (Leptoprosopic)	90.58
Jugo-mandibular index (I 40)	62.32
Jugo-malar index (I 41)	71.74
Kollman's upper facial index (I 39) (Mesen/middle upper face)	54.35
Orbital index (I 42) (Mesochonch/medium orbit)	R:82.22, L:81.82
Inter-orbital index (I 46a)	28.16
Nasal index (I 48) (Leptorhinae/ narrow nose)	44.44
Maxillo-alveolar index, Palato-alveolar index (I 54) (Mesuranic)	112.50
Palatal index (I 58) (Brachystaphylin/ broad palate)	105.41
Alveolar index, gnathic index (I 60) (Orthognathous)	83.49
Face modulus (I 61)	118
Mandibular index (I 62) (Dolichostenomandibular)	71.68
Condylar index (I 63)	R:49.25, L:50.00
Gonio-condylar index (I 64)	76.11
Longitudinal cranio-facial index (I 69)	49.19
Vertical cranio-facial index (I 70)	60.00
Transverse cranio-facial index (I 71)	107.81
Fronto-orbital index (I 72)	90.27
Jugo-frontal index (I 73)	73.91
Palatal height index (I 59) (Hypsistaphylin/ high palate)	46.15

Besides the robust features, there are morphologically two noticeable aspects – open metopic suture and very large sized wormian bone in the lambdoid region.

Not many specimens of open metopic suture are known in the Indian context. The metopic suture in the Abhaipur specimen is one of the rare examples in this regard (Fig. 10). The frontal bone at birth is divided into two halves bilaterally by a metopic suture. This suture usually closes between the first and second years of life, but may rarely persist throughout life as a discrete suture

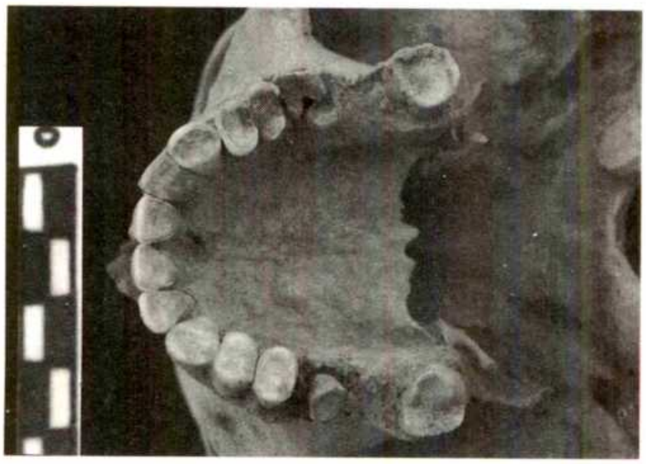

Fig. 8: Maxilla

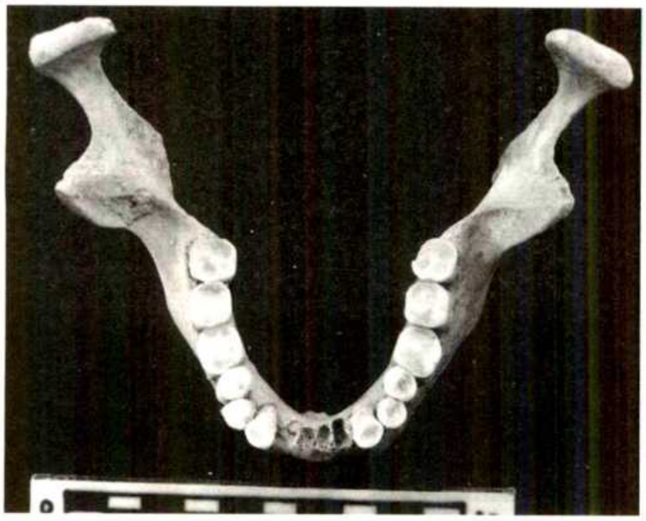

Fig. 9: Mandible

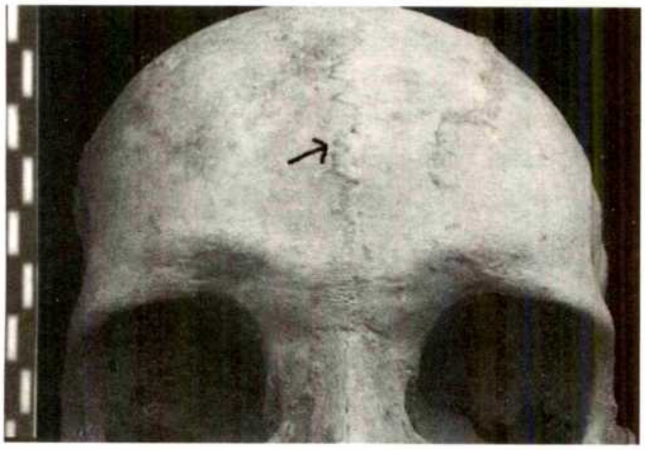

Fig. 10: Metopic suture on the frontal

separating the frontal bone. Inheritance of openness of metopic suture is presumed to be genetically determined. A higher incidence of open metopic suture is reported for males. Open metopic suture more commonly manifests itself as a partially obliterated suture persisting only as a remnant extending 2 or 3 cm above the nasofrontal suture, like the one reported for one sub-adult specimen of Neolithic Burzahom (Basu and Pal 1980). The remnant suture seldom penetrates deeper than the outer table of the frontal bone, or it may not penetrate the outer table at all (El-Najjar and McWilliams 1978). The metopic suture in the Abhaipur specimen is faint, but visible in its entire length (130 mm) from the nasion to bregma. The inner table, since the cavity is filled with matrix, cannot be examined. Judging from the faintness of the sutural line it appears that only the outer table is affected.

The other noteworthy feature is the high incidence of large-sized 'wormian bones' near the lambdoid region. The wormian bone is rectangular shaped, the dimensions being 5.5 x 5.5 cm (see Fig. 6).

The aetiology of wormian bones along the lambdoid suture is not precisely known. This anomaly is either attributed to stress brought about by cranial deformation (Bennett 1965), or taken as developmental malfunction possibly having a genetic component (Torgerson 1951; Hess 1946). Untimely closure or defects in the suture closing process may produce extra bones. Pedigree studies have shown that such developmental malfunctions causing wormian bones are inherited as a dominant trait with an incidence of around 50% (El-Najjar and McWilliams 1978).

Post-cranial elements

The skeleton of the thoracic cage is slightly damaged; nevertheless ribs of both the sides are present in fragmentary state. There is slight post-mortem warping for the right middle portion, probably because of pressure of the burial filling, which could easily be mistaken for wound marks (Fig. 11). It should be noted that the edges of breaks seen on the ribs near the warped portion are irregular, and very unlikely to have caused by any sharp pointed/flat or blunt metal weapon.

All the seven cervical vertebrae are present and could be recovered in an unbroken state. Morphologically, there appears to be slight asymmetry in the size and position of foramina transversarium (Fig. 12). Also the bifid nature of cervical spines is not seen in the later elements (C6 and C7). In the third cervical (C3) the bifid spine is asymmetrically expressed, the left side of the spine is much smaller than the right side (Fig. 13).

The third and sixth cervical vertebrae exhibit slight amount of porosity. The edges of bodies are extended; the forth and the sixth are more affected with this pathology. Also there is new bone formation on the superior aspect of body of the 6th cervical vertebra.

There is slight amount of bone growth on the right side of articular surface of atlas (Fig. 14), and the corresponding area on the odontoid process of axis is also seen responding to the lesion. The inferior articular surfaces of atlas seem to be extended dorsally, but this may be taken in normal range of variation, as no change is noticeable on the superior articular surfaces of axis. It may be mentioned here that slight amount of new bone formation is seen along the left side of the edge of the foramen magnum also, which seems to be coincidental with the changes seen on the atlas and axis. Like the cervical region vertebrae the thoracic region too exhibits porosity in varying degrees on bodies.

There are Schmorl's nodes on thoracic tenth and eleventh vertebrae (Fig. 15). This osteophytic growth seen on the inferior and superior aspects of these vertebral bodies corresponds with the uneven depressions observed on the ninth and twelfth vertebrae. There is size discrepancy in the superior articular facets of T3 (Fig.16).

The fourth lumbar also exhibits Schmorl's nodes, and on this vertebra, on its right side of superior surface, there is some infection which could diagnosed as vertebral osteophytosis. The severe osteophytic growth seen on the fifth lumbar corresponds with changes in superior articular surface of sacrum. The lumbar is not fully sacralized though.

Sacrum is damaged post-mortem in its right dorso-lateral aspect. But significant amount of new bone formation is seen on its articular process.

Vertebral osteoarthritis is the most commonly occurring joint disease seen in archaeological human groups. It is a direct consequence of spinal stress. The inter-vertebral discs consist of fibrous tissue. With advanced age a chemical and degenerative change occurs in these tissues. Constant stress in the bending and lifting of everyday activity causes problems in these regions. The mechanical stress and strain upon each segment of the spine is constant due to upright posture. Due to curves of the vertebral column the fifth cervical, eighth thoracic and fourth lumbar vertebrae are more affected than others. Rupture of the fibrous tissue of the discs stimulates the growth of bone from the margins of the vertebral body. The anterior area of the vertebral body is more liable to the process of osteophytosis (bone growth) than the posterior area. Apart from the vertebral body surfaces, the posterior apophyseal joints and transverse process joints of the vertebrae are also affected in osteoarthritis. Intermittent backache, the stiffness and inability to touch the toes are familiar features of this ageing process.

Continued osteophytic growth results in union of adjoining vertebrae and gradual stiffening of the spinal segment. The symptoms are hampered movement, and inefficiency in performing activities that require bending of

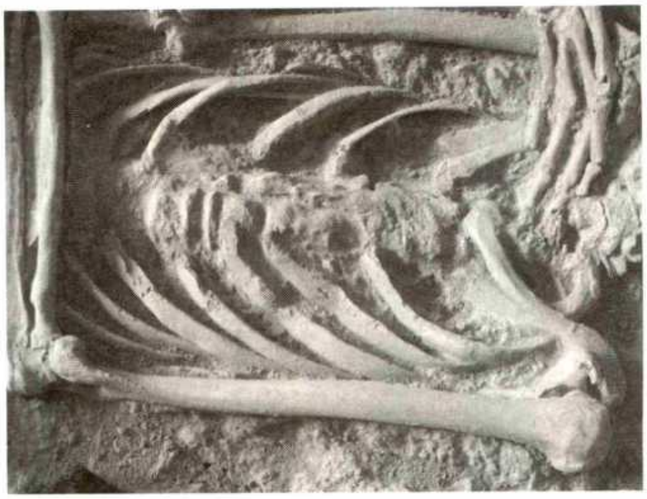

Fig. 11: Post-mortem damage resembling as wound marks

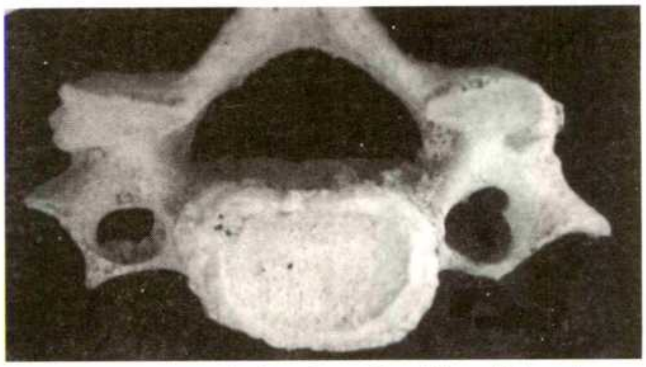

Fig. 12: Asymmetry in the size and position of foramina transversarium

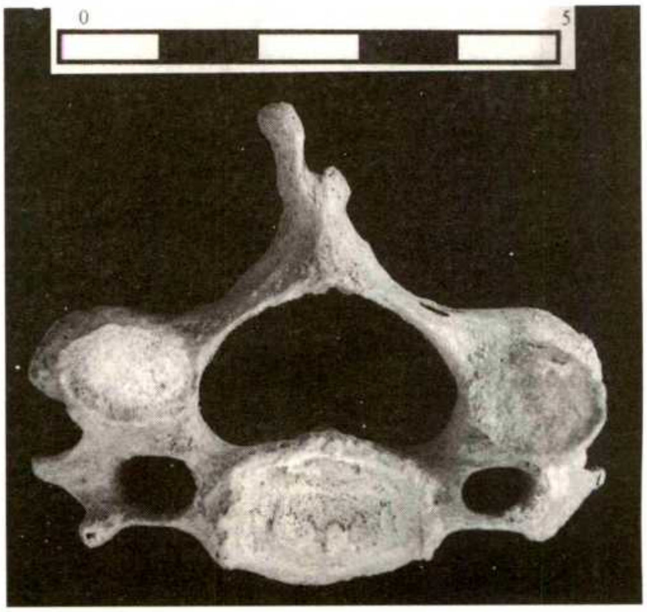

Fig. 13: 3rd cervical vertebra: asymmetrical bifid spine

the axial skeleton. Men and women engaged in heavy manual work are more liable to develop osteophytosis than the sedentary worker (Nathan 1962). So also, increase in age, a genetic predisposition, obesity, and environmental factors such as climate may all contribute to its development (Roberts and Manchester 1995).

Associated with osteophytosis and degeneration of the inter-vertebral discs are the Schmorl's nodes, where the disc contents exert pressure on the vertebral body surface.

The Schmorl's nodes are generally seen on the lower thoracic and lumbar vertebral body surfaces. The lesion is described as a degenerative pathology. It has been noticed that the intensity of this pathology depends on the age and stress factors, and occurs when the inter-vertebral disc starts degrading due to stress (Resnick and Niwayama 1988). Yet their specific aetiology remains unknown in most cases. Trauma has been implicated as one of the major causes of this condition, with underlying infection, and when osteoporotic or neoplastic states weaken the bone structure, there are higher chances of Schmorl's nodes to develop.

Like the elements of cervical region the thoracic vertebrae too exhibit a few genetic anomalies. Besides asymmetrical expression of superior articular process of the twelfth thoracic, and deviated angle of spine of the forth thoracic (Fig. 17), more noteworthy is incompleteness of the neural canal of first thoracic (Fig. 18). The left pedicle of this vertebra looks broken, but the change is less likely to be traumatic in origin, despite the fact that the ends of the 'breakage' look partially 'healed'. Any injury to this region of this magnitude would seriously damage the surrounding skeletal tissue, and may even lead to paralytic state. The preceding and subsequent vertebrae are normal so far as this pathology is concerned. Therefore, more convincingly the change could be a genetic anomaly.

The most enigmatic feature is noticed for the lumbar region. As mentioned earlier, the skeleton was lifted from the site along with matrix. The individual was interned in extended posture with hands folded over the lumbar region (abdomen) (Fig. 2). The lumbar vertebrae were not exposed in the field since hand bones were overlying them. This was excavated in the museum by the first and third author under the supervision of the last author and the adequate documentary record (in the form of a photograph after every fifth minute) was kept of the whole exercise. The reason for restating this procedure is the enigmatic absence of one lumbar vertebra, a condition very rarely noted in archaeological records. There are only four lumbar vertebrae, and the authors categorically deny any loss during the excavation process. It is very difficult to comment which one was missing, but it could be any one in the lumbar region, or the last thoracic. The vertebral body of the 12th thoracic is broken, making it difficult to judge the rib-articulation facets.

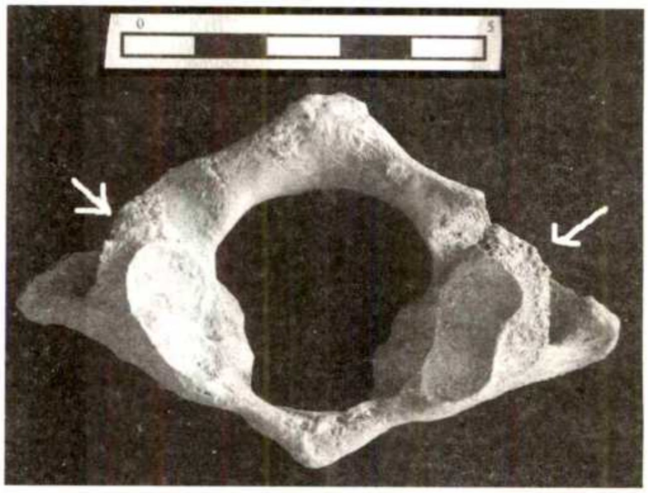

Fig. 14: Note the bone growth on the edge of the atlas

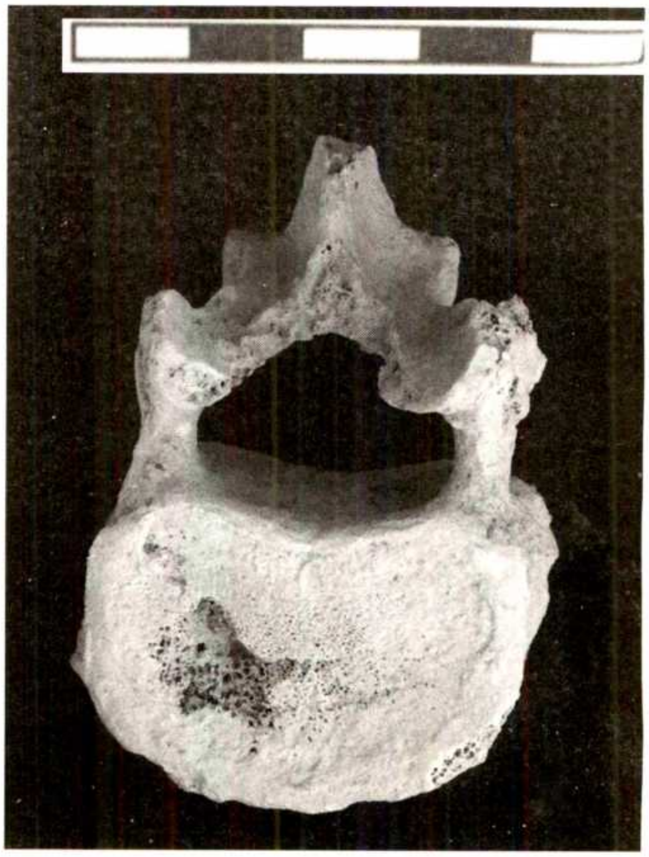

Fig. 15: 12th thoracic vertebra: Schmorl's nodes

Variation in the number of pre-sacral vertebrae (PSV) appears to be a normal occurrence, though literature on the subject is sparse and dated. The condition in most cases is not pathological. Diseases that are known to result in missing lumbar/thoracic vertebrae are Spondylocostal dystosis (Karakurt 2001; Bates and Nale 2005), Talipes equinovarus (Carey 2003) and Currarino syndrome

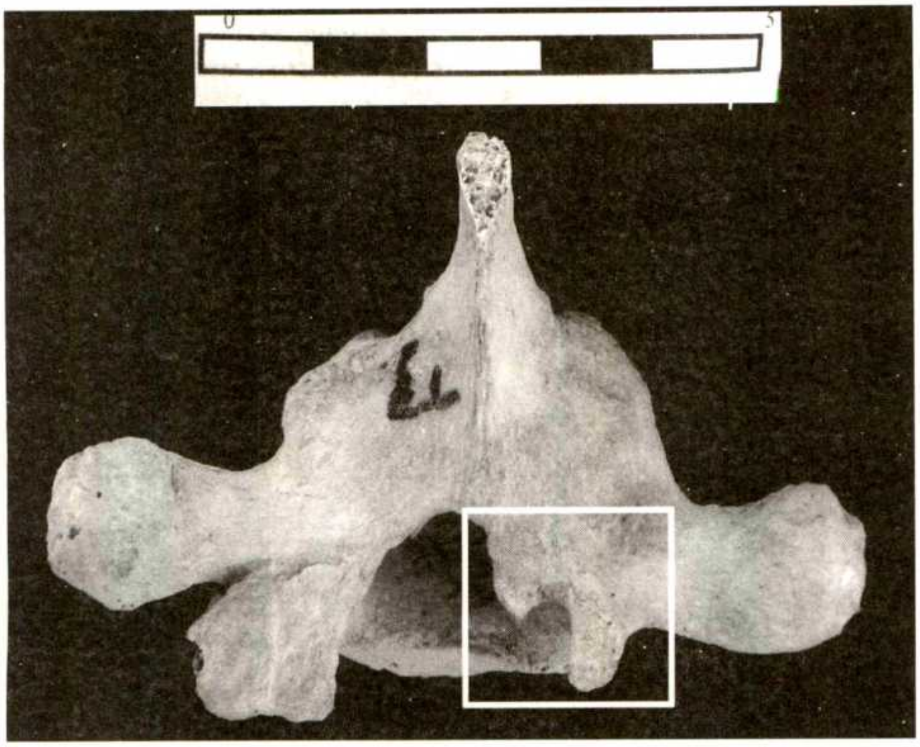

Fig. 16: 3rd thoracic vertebra: size discrepancy in the superior articular facets

(Belloni 2000). All these are, however, accompanied by severe deformities that this individual does not possess.

Barclay-Smith (1911, quoted from Ortner, 1980) has reported presence of 8 cervical vertebrae in a female skeleton, dated to 600-500 B.C., from Egypt. The authors relate this developmental malformation to early training and activity as a contortionist.

Fewer than 25 vertebrae may result from reduction of a thoracic or lumbar vertebra or by assimilation of the atlas with the cranium (Kaufman 1974). Statistically significant differences may exist between different ethnic groups. Bornstein and Peterson (1966) had examined a large skeletal series from Mongoloid, Caucasoid and Negroid population groups in North America for variations in the number of PSV. This study strongly supports the conclusion that the total frequency of variation in the number of PSV is a specific characteristic of any particular population. Negroids seem to possess 23 vertebrae more frequently than Caucasians and Mongoloids. Numerical variation of vertebrae is not associated with age, but gender differences do exist, women more likely to possess fewer vertebrae than men do. Kaufman (1974) examined variation in number of PSV in four tribal groups of Southern African Peoples. He observed the total incidence of numerical variants (23 PSV and 25 PSV) as 19% in males and 12.1% in females. This study indicates higher frequency of 25 PSV in males, while females show higher frequency of 23 PSV.

However, it may be noted that the other peculiarities noted in the Abhaipur skeleton (i.e. persistence of the metopic suture, wormian bone at lambda, open neural canal) seem to have appeared by chance in a single individual, and are probably unrelated with the variation in the PSV number.

Besides the age-related pathology discussed above, the sacrum is normal. The neural canal opens from the fifth vertebra. There is a prominent notch on the inferior margin of the left superior articular process. It could be a post-mortem phenomenon.

The bones of appendicular skeleton exhibit robusticity of varying degree. Most of the long bones are complete, and the extremities are well preserved. Table 3 gives metric data on post-cranial bones. The individual is tall. Table 4 gives the values of estimated stature based on various bones.

All long bones of this specimen are preserved in excellent condition, allowing measuring maximum length. One discrepancy needs to be noted for stature values. All the four bones of lower segments of upper and lower extremity, radius-ulna and tibia-fibula, give higher values of stature, than those derived from the bones of the upper segment, humerus-femur. No explanation can be offered for this anomaly. This could be within a normal range of variation, or even a genetic feature, as well. Such discrepancy has been noted in the Iron Age specimen from Kodumanal (Mushrif and Rajan, in press)

Table 3: Osteometric data (in mm; estimates are given in parenthesis)

Measurement	Right	Left
Clavicle		
Maximum length	15.6	(15.6)
Verticle diameter in middle	12.5	12.5
Sagittal diameter in middle	9	8
Girth in middle	33	31
Caliber index, robustness index	211.53	198.71
Cross section index	138.88	156.25
Claviculo-humeral index	44.57	43.94
Humerus		
Maximum length	35.5	35.5
Breadth of proximal epiphysis	49	49
Breadth of distal epiphysis, breadth of epicondyle	63	64
Maximum diameter in middle	24	22
Minimum diameter in middle	18	18
Girth in middle of shaft	68	65
Cross section index of shaft	75	81.81
Robusticity index, caliber index	50.70	50.70
Radius		
Maximum length	27.7	27.7
Least girth of shaft	40	40
Transverse diameter of shaft	16	15
Sagittal diameter of shaft	13	13
Caliber index, robusticity index	144.40	144.40
Cross section index of shaft	81.25	86.66
Ulna		
Maximum length	29	29
Girth of ulna	34	35
Dorso-volar diameter	17	17
Transverse diameter	14	13
Caliber index, robusticity index	117.24	120.68
Cross section index of shaft	121.42	130.76
Femur		
Maximum length	48	48
Physiological length	47.5	47.4
Maximum trochanter length, trochanter-condylar length	47	47
Sagittal diameter at mid-shaft	29	30
Transverse diameter at mid-shaft	28	29
Girth at mid-shaft	94	94
Upper transverse diameter of shaft, transverse diameter at subtrochanterion	34	35
Upper sagittal diameter of shaft, anteri-posterior diameter at subtrochanterion	27	26
Least lower sagittal diameter of shaft	29	29
Lower transverse diameter of shaft	35	36
Epicondylar breadth or condylar breadth	78	78
Length-thickness index	197.89	198.31
Robusticity index	120.00	124.47
Pilastric index	103.57	103.44
Platymeric index	79.41	74.28
Range variation (Martin-Saller 1957)	Platymeric	Hyperplatymeric
Sagittal index of lower half of shaft	100	96.66
Transverse index of lower half of shaft	125	124
Popliteal index	82.85	80.55
Patella		
Maximum height	42	43
Maximum breadth	46	46
Maximum thickness	22	22
Height of articular surface	34	34
Height index	46.47	48.04
Height-breadth index	91.13	93.44
Tibia		
Total length of tibia, lateral condylar-malleolar length	41.8	41.5
Maximum sagittal diameter at mid-shaft	30	30
Maximum transverse diameter at mid-shaft	20	21
Girth of shaft	84	85
Minimum girth of shaft	80	79
Length-thickness index	191.39	190.36
Fibula		
Maximum length of fibula	40	39.5
Maximum diameter in middle	16	15
Minimum diameter in middle	10	10
Girth in middle	45	45
Cross-section index in middle	62.5	66.66
Calibre index	112.5	113.92

Table 4: Stature estimation based on bone length measurement

Bone	Side	Length (cm)	Stature (cm)
Humerus	R	35.5	179.79 ± 4.05
	L	35.5	179.79 ± 4.05
Radius	R	27.7	183.72 ± 4.32
	L	27.7	183.72 ± 4.32
Ulna	R	29.0	181.35 ± 4.32
	L	29.0	181.35 ± 4.32
Femur	R	48.0	175.65 ± 3.27
	L	48.0	175.65 ± 3.27
Tibia	R	41.8	183.96 ± 3.37
	L	41.5	183.20 ± 327
Fibula	R	40.0	178.98 ± 3.29
	L	39.5	177.64 ± 3.29
Femur + Tibia	R	89.8	180.03 ± 2.99
	L	89.5	179.64 ± 2.99
Mean stature			180.32

Morphology and pathology

Clavicle

The left clavicle is slightly damaged at the medial end. There is bilateral asymmetry in the expression of costo-clavicular ligament. the right side is thicker (12 mm) than the left side (12 mm, as against 9 mm in mid-shaft girth). The changes can be taken as markers of occupational stress and may provide clues to infer the daily activity patterns of individuals. In short, these are changes produced by stress, and the assumption that follows is that the degree and type of change is related directly to the amount and duration of habitual stress placed on specific muscles.

There are a variety of activity-induced changes, more commonly, pitting of outer bone surface and robusticity. It is a normal reaction of the skeleton to habitual muscle usage and reflects daily activities that produce rugged markings at the musculoskeletal site of attachment. It is seen in its most extreme expression as sharp ridges or crests of bone. Robustness of costo-clavicular ligament may be taken as modification caused by specific occupational activity, involving repetitive usage of the upper extremities. The more pronounced change on the right clavicle suggests more stress on the right side, like carrying heavy agricultural equipment, etc. It may be noted that morphometric disparity on clavicles is seen on many Neolithic specimens that is taken as a body response to manual ploughing (Walimbe, in press).

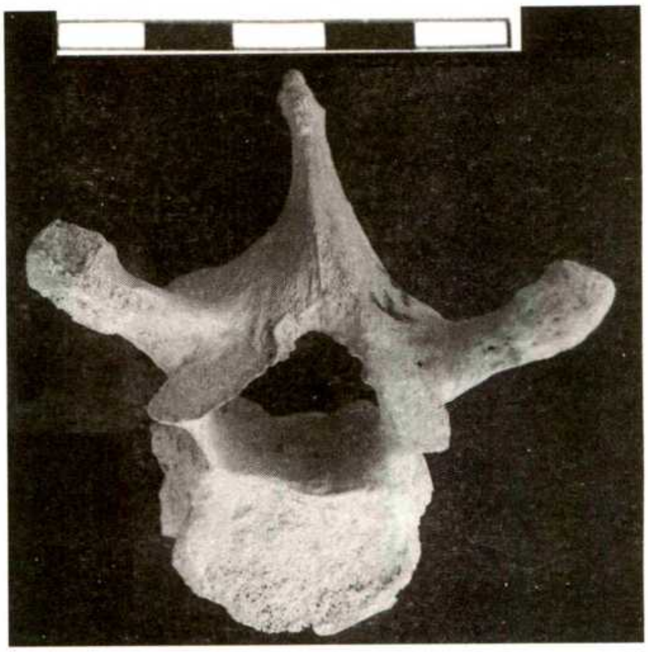

Fig. 17: 4th thoracic vertebra: deviated angle of spine

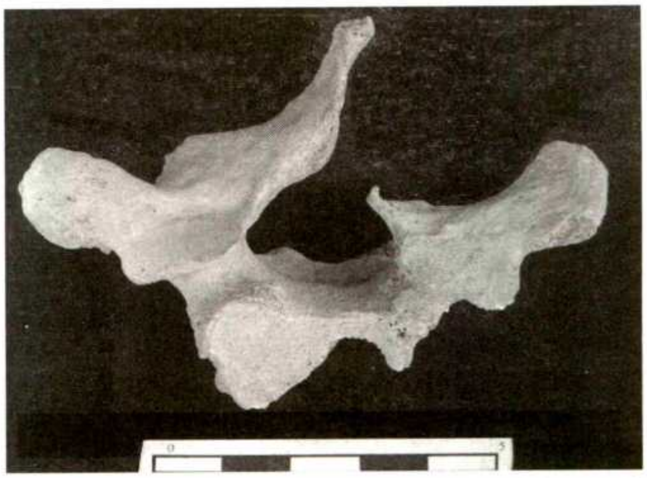

Fig. 18: 1st thoracic vertebra: incompleteness of the neural canal

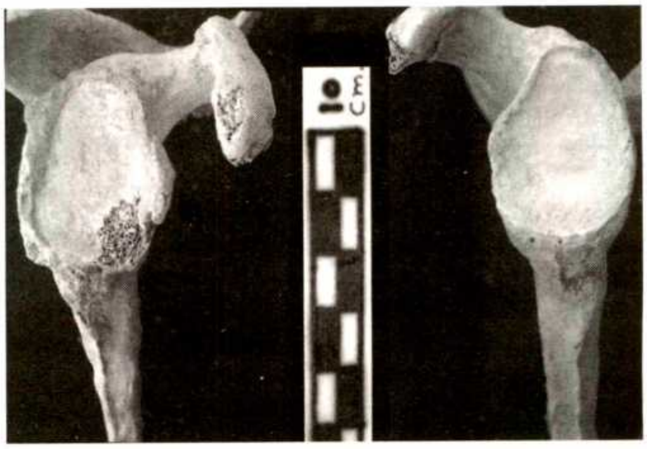

Fig. 19: New bone formation on the RL glenoid cavity of scapula

Scapula

Secondary bone formation is seen on all along the edges of glenoid cavity, more severe on the right side bone. (Fig. 19) The axillary border of the right side bone is also more robustly built than the left side.

Humerus

The bones are moderately built, with well developed deltoid region. A medium sized foramen is seen in the olecranon fossa region on both sides. There is slight discrepancy in the girth dimensions in the bones – the right one is bigger than the left. The habitual stress may have induced robustness of the right bone, but slight lateral twisting seen in the proximal shaft just above the deltoid region may have been equally important. There is extra bone growth seen in the form of ridge all along the edges of head, which is again seen more on the right bone. The lateral twisting is not clearly visible in the radiograph, but there is no indication of any serious injury (Fig. 20).

The secondary bone formation seen on the edges of glenoid region of scapulae and head of the humerus seems to be age related, osteoarthritic (Fig. 21). Twisting of right bone might have accelerated the bone reaction further.

Ulna

Both right and left ulna bones are robust. Inter osseous crests are sharp.

Radius

Both right and left radial tuberosities are robust, but rather than having the whole region developed, there is a ridge like development towards the anterior edge of the tuberosities. The feature appears symmetrically on both sides. Also some striation marks are seen in the region.

Bones of hand

All carpals, metacarpals and phalanges are preserved for the right side. There is no unusual morphological lesion on any of these bones, besides the robustness. However, there are markings of degenerative changes involving extensions of articular surfaces of carpal bones, the changes are more prominently seen in navicular and lunate. Except for carpal bones that are missing from the left side, inventory is complete for the left side also. No pathological or morphological changes are seen on any of the bones of this set.

Pelvis

The left innominate is preserved completely. The right side obturator foramen is broken. Pubic symphysis is lost. The pelvis shows male features and the sciatic notch is of grade 5. The acetabulum is deep for both sides with an uneven edge and a slight modification in the form of an uneven surface and striations which are prominently seen on bones on both sides (Fig. 22). There is anomalous bone growth in the inner medial wall of the obturator foramen on the left side bone. There is no new bone formation or any other bone modification consequently the spur can not be taken as traumatic in origin. The robusticity of the individual is seen in innominates in the form of prominent illac crests and moderately developed ischial spine.

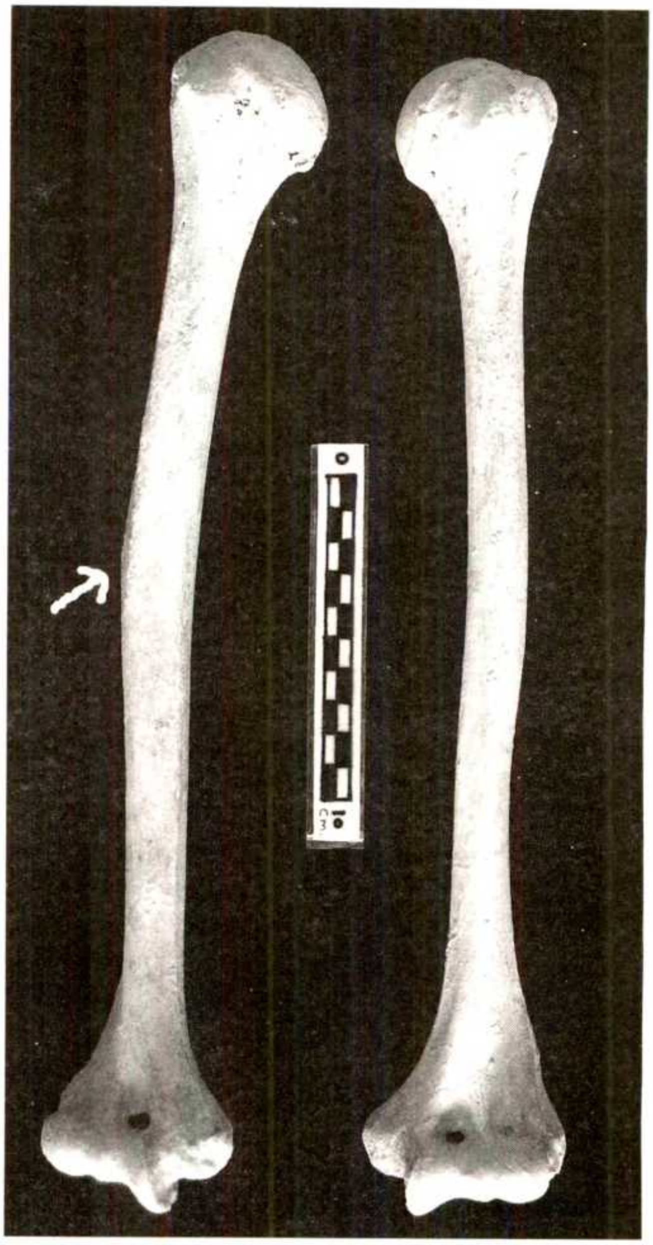

Fig. 20: Twisting of the right humeral shaft near deltoid region

Femur

Bones of both sides are complete, except for some damage to the greater trochanter, causing loss of the tip. The inter-trochanter line is more prominent on right femur than the left. Besides this on the right femur, there is a plate like

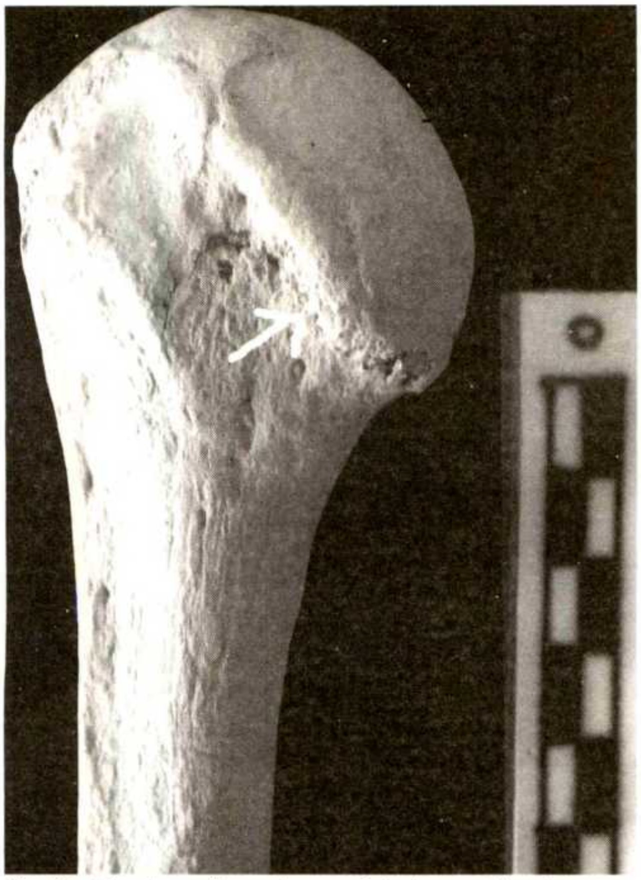

Fig. 21: New bone formation on right humeral head

formation on the lesser throchanter; the corresponding region on left is also equally robust but there is no plate like formation. There is also bilateral asymmetry in the expression of the spiral line where the right bone is well marked whereas on the left only faint marking is seen. The linea aspera are moderate on both.

A few abnormal features were noticed on the bones.

There is a suspected 'crack' on right side bone between the in the inter-trochanter region which runs more than 2 cm cutting the cortex. Medially the borders of the crack are 'open', and extends into the post-mortem damage that has occurred to the greater trochanter, which hints at its post-mortem origin. It could be a partially healed fracture that occurred a few days prior to death of the individual. There is slight secondary formation near the lateral end of the suspected crack which might be indicative of beginning of the healing process (Fig. 23). It could be a morphological exaggeration of the inter-trochantric line.

On the left femur, towards the distal end, 2 cm above the lateral condyle there is a prominent spur like development. This is (more than 1 cm long, 0.5 cm thick) anomalous bone spur with a blunt, plate-like end on the lateral side (Fig. 24). There is no sign of any infection or any other kind of morphological change near the tip of the spur. There are two possible aetiologies. The lesion could either be traumatic in origin or it could be neoplastic. The radiograph taken for the bone neither revealed any break in cortex nor any new lamellar bone formation. Thus the traumatic origin cannot be accepted.

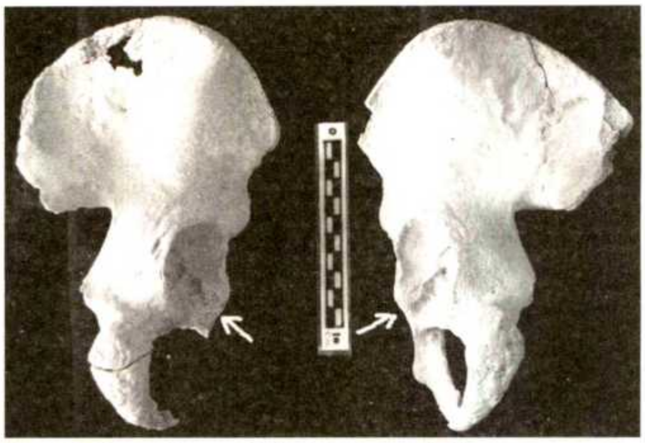

Fig. 22: Bone changes in both RL acetabulum

Neoplasm or new growths are in essence the uncontrolled growth of tissue cells. The lesion in the Abhaipur specimen can be diagnosed as a benign neoplasm where the growth remains solely at the site of origin and tends to spread only locally without a generalized bodily effect. Such lesions remain discrete and of varying size/shape, and are commonplace findings in skeletal remains of antiquity (Roberts and Manchester 1995). Most of them are without any symptoms. There is a possibility of the lesion in the given specimen falling in osteoid osteoma category, where the lesion is more commonly seen towards the ends of tibia or femur. There is no fusiform swelling in this case. But this kind of neoplastic growth tends to produce considerable pain and discomfort.

Medially on the same bone, approximately at the same height (2 cm) above medial condoyle, there is a nodule of 0.8 cm diameter. In this case there is no spur like development. Interestingly this feature, probably morphological and not pathological, appears on the right side bone also, exactly at the same location. There is bone development on both right and left lesser trochanters (Fig. 25). A radiograph of the femoral proximal shaft confirms osteoarthritis of the bone (Fig. 26).

Patella

The patella bones show signs of robusticity, and age related arthritic modifications. There are excessive muscle markings on the anterior surface. On the articular surface, medially, there is new bone nodule formation on both patellae (Fig. 27). These are degenerative pathological changes. The corresponding portion on the patellar articular surface of both femora shows a ridge that runs

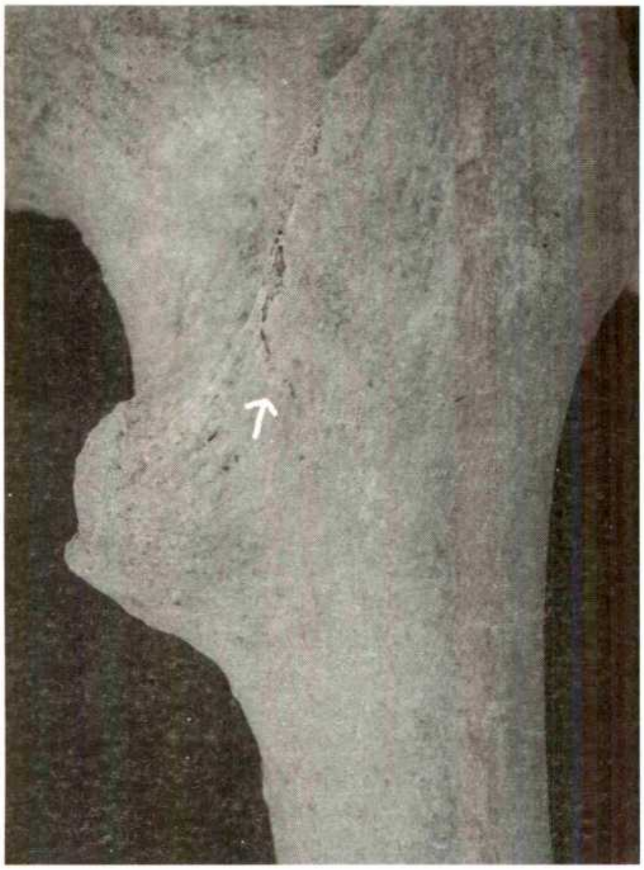

Fig. 23: Suspected fracture on the right femur near the intertrochanter region

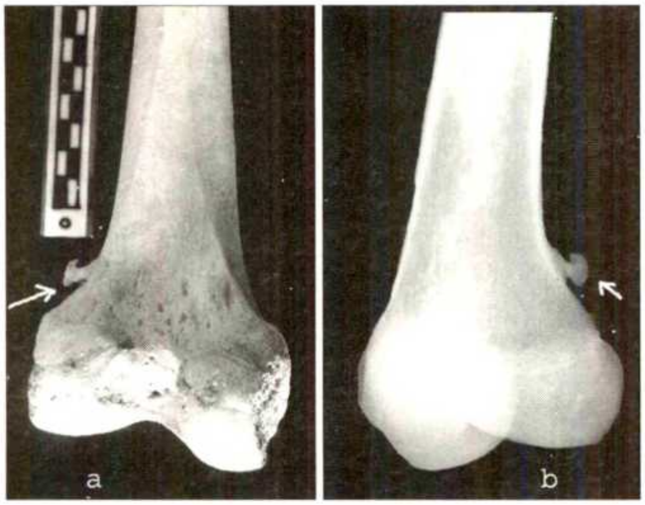

Fig. 24: left Femur: a. Spur like development, b. radiograph of the bone

2 cm, medio-laterally. There is a moderate amount of porosity on the inner side distally to articular surface, which is more prominent on the right side bone. This porosity has resulted in slight ridge like development of the inferior border of bone. This could be probably related to infection.

The changes seen in patella, distal femur, or even the scapula, are age related degenerative arthritis. Degeneration of articular cartilage is an age related slow process involving physiological wear and tear of the joints. The earliest and most often affected joint is the knee, followed by other joints like the hip, shoulder, the elbow, etc. In the knee joint, the articular changes begin in the patellar cartilage followed by lesions on the patellar facet of the femur, then on the tibial condyles. Significant bone changes usually develop many years after the initiation of degenerative and proliferate cartilage changes. Such changes usually begin at the margin of the articular cartilage and manifest themselves as marginal lipping and exostosis. It is the most common of all the articular diseases.

Tibia

The popliteal line is moderate in case of both right and left bones. Tibial tuberosity is more prominent in the right tibia. Similarly, the condylar surface of this bone is slightly extended medially.

Fibula

There is length discrepancy; the left side bone is 0.5 cm longer than that the right side. For the right fibula the articular surface on malleolus for talus is extended. This could also be age-related pathology.

Bones of the foot

The skeleton of the foot is complete for both sides, including the small-sized metabones. There is no aberrant morphological feature seen on any of the bones. There are however, some age related changes in the tarsal bones where slight new bone formation is seen on the edges of articular surfaces.

Description of dental elements

The dental inventory is complete except for the ante-mortem loss of maxillary RLM2; and mandibular LI1 is lost post-mortem. The teeth are heavily worn out precluding observations on occlusal morphology. Table 5 gives values of dental crown dimensions (in mm) and indices.

In dental dimensions the Abhaipur specimens conform to the dental pattern seen for the Indian protohistoric dental series, except for the fact that the mandibular M3s are larger than the M1s in MD dimension. In maxilla, left side teeth are smaller than the right side. Since the molar series is not complete/measurable, TCA or MCA values cannot be calculated. Table 6 gives the values of attrition grades.

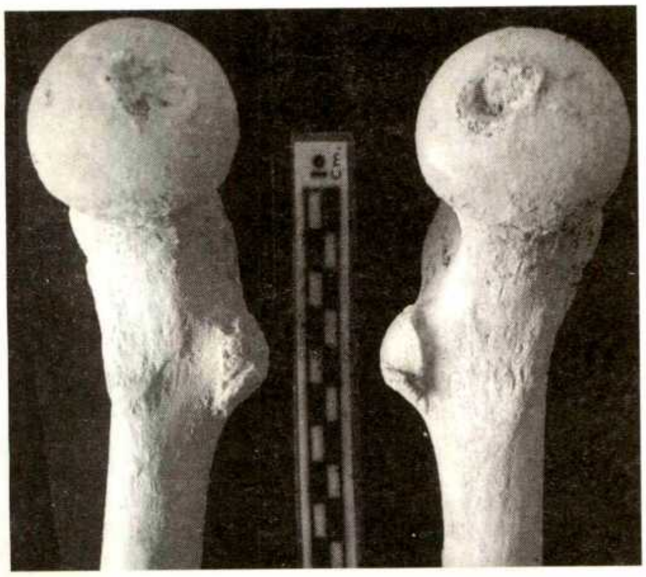

Fig. 25: RL Femur: note the bone development on lesser trochanter

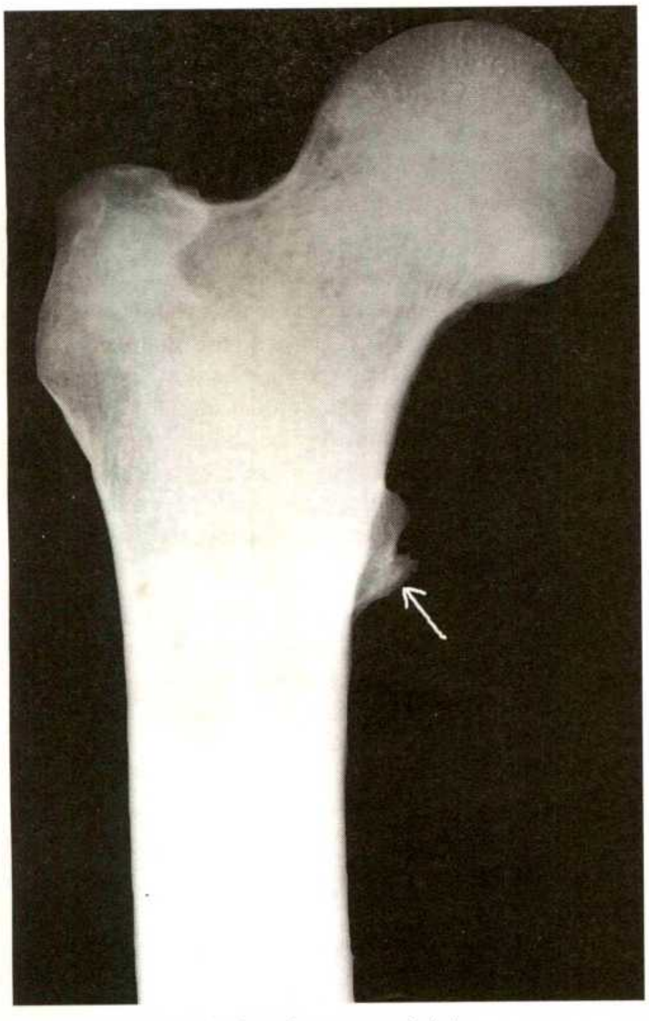

Fig. 26: Radiograph showing osteoarthritis

Table 5: Odontometric data: Abhaipur adult

Tooth	Side	MD	BL	CA	CI	CM
Maxilla						
I1	R	7.17	6.98	52.14	102.72	7.07
	L	7.26	7.49	54.37	96.92	7.37
I2	R	6.83	6.74	46.03	101.33	6.78
	L	6.50	6.90	44.85	94.20	6.70
C	R	8.66	8.67	75.08	99.88	8.66
	L	7.85	8.40	65.94	93.45	8.12
Pm1	R	6.59	9.11	57.30	72.33	7.85
	L	6.28	8.78	55.13	71.52	7.53
Pm2	R	6.76	9.29	62.80	72.76	8.02
	L	6.22	9.18	57.09	67.75	7.70
M3	R	9.64	11.36	109.51	84.85	10.50
	L	9.79	11.19	109.55	87.48	10.49
Mandible						
I1	R	4.55	(5.00)	22.75	91.00	4.77
I2	R	5.47	(5.20)	28.44	105.19	5.33
	L	5.48	(4.68)	25.64	117.09	5.08
C	R	7.13	7.61	54.25	93.69	7.37
	L	7.18	(8.02)	57.58	89.52	7.60
Pm1	R	6.81	7.03	47.87	96.87	6.92
	L	6.62	7.01	46.40	94.43	7.28
Pm2	R	7.26	8.08	58.66	89.85	7.67
	L	7.38	8.13	59.99	90.77	7.75
M1	R	11.10	10.58	117.43	104.91	10.84
	L	11.15	10.70	119.30	104.20	10.92
M2	R	10.40	10.14	105.45	102.56	10.27
	L	10.56	10.22	107.92	103.32	10.39
M3	R	11.33	10.44	118.28	108.52	110.88
	L	11.36	9.86	112.00	115.21	10.61

Maxillary RLM1s are not measurable

Besides the ante-mortem tooth loss of maxillary RLM2, other dental pathologies seen for upper teeth include interproximal caries on distal/mesial aspects of LPm1 and LPm2. The LM1 is heavily worn out, but still held in the jaw as two separate pieces. The RM1 also shows attrition of higher degree. The enamel cover for all the four incisors is lost on the lingual side. Besides masticatory stress, specific behavioural activities, and/or processing of plants for consumption, might have caused this damage. Tartar accumulation is moderate, not as severe as in the mandible.

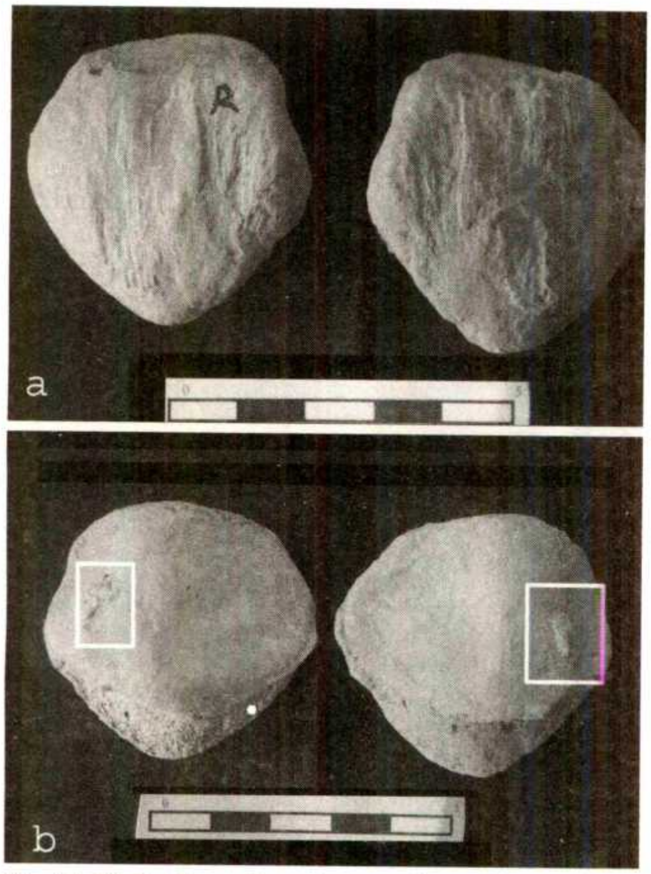

Fig. 27: RL Patella: a. Excessive muscle markings on the anterior surface, b. bone nodule on the posterior surface

Table 6: Wear pattern

Tooth	Side	Maxilla	Mandible
I1	R	7	5
	L	7	-
I2	R	7	5
	L	7	5
C	R	7	5
	L	7	5
Pm1	R	5	5
	L	6	7
Pm2	R	5	5
	L	7	7
M1	R	10?	8
	L	10?	8
M2	R	-	7
	L	-	7
M3	R	8	9
	L	8	9

Mandibular teeth are free from caries, but there is severe tartar accumulation on all teeth, most severe on incisors and that too on LI2. (Fig. 28)

Age estimation

Looking at the dental wear and completely fused cranial sutures the age at the time of death is estimated as 50+ years.

Sex determination

The individual is robustly built, and all the muscle attachment areas on bone are pronounced in varying degrees. The most diagnostic feature for determining sex is the sciatic notch, which is narrow and deep (grade 5), and it confirms that it is a male specimen.

B. Sub-adult individual

The sub-adult skeleton was very poorly preserved, and only a few long bones could be traced. The skull was badly damaged. No cranial or facial bone could be retrieved in complete state. Only one long bone (right femur) allows fair estimation of diaphyseal length, which is 16.0 cm.

The right femur was X-rayed and interesting the bone gives evidence of Harris lines. There are at least three lines depicted on the proximal side (Fig. 29). The lowermost line is not very distinct, but the middle one is thick and runs along almost 2/3rd of bone. The third line is dark but slightly blur because it is located near the metaphyseal region.

Radiopaque transverse lines found on growing end(s) of long bones, running horizontal to the epiphyseal end(s), are commonly referred to as Harris Lines, after the discoverer (Harris 1931, 1933). Such lines can be observed in apparently healthy as well as chronically ill infants or children as a result of numerous metabolic insults. They record a suspension of growth followed by a recovery period of catch-up growth and taken as an evidence of childhood illness and index of morbidity in a given population (Wells 1964).

Harris line formation is attributed (Park 1964; Steinbock 1976) to episodes of bone growth disruption in which cartilage cell division slows or stops while mineralization is allowed to continue, resulting in abnormal formation of bone structure. In the recovery period, when growth resumes, the cartilaginous plates of long bone move longitudinally, leaving behind rings of increased mineralization, density and radiopacity. These lines thus are not simply 'growth arrest lines' but more accurately, 'recovery lines'.

Estimated age at the time of death for the Abhaipur sub-adult is around 2 years (see below). The three lines seen on the right femur represent three episodes of stress

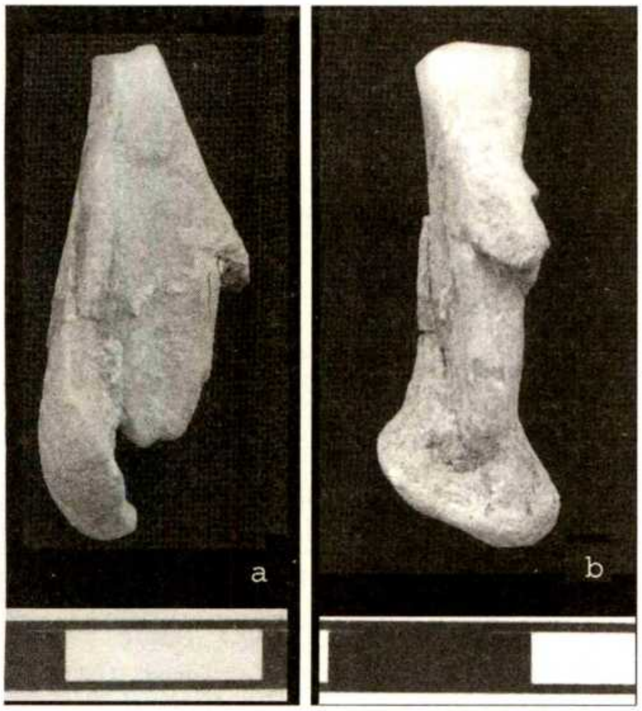

Fig. 28: Tater accumulation on the mandibular first incisor: a. medial view, b. lingual view

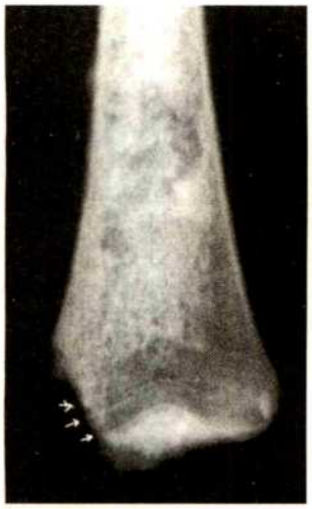

Fig. 29: Harris lines on the R femur of sub adult individual

Table 7: Odontometric data: Abhaipur sub-adult

Tooth	Side	MD	BL	CA	CI	CM
Maxilla						
Di1	R	6.91	5.50	38.00	125.63	6.20
	L	7.07	5.48	38.74	129.01	6.27
Di2	R	5.57	5.36	29.85	103.91	5.46
	L	5.66	5.22	29.54	108.42	5.44
Dc	L	6.99	6.27	43.82	111.48	6.63
Dm1	L	8.19	9.15	89.08	89.50	8.67
Dm2	R	10.21	10.36	105.77	98.55	10.28
I1	L	8.90	-	-	-	-
M1	R	11.27	11.22	126.44	100.44	11.24
Mandible						
Di1	R	4.51	4.47	20.15	100.89	4.49
	L	4.43	4.27	18.91	103.74	4.35
Di2	R	4.91	4.68	22.97	104.91	4.79
	L	4.84	4.62	22.36	104.76	4.73
Dc	L	6.22	5.68	35.32	109.50	5.95
Dm1	L	9.20	6.55	60.26	140.45	7.87
Dm2	L	11.61	9.26	107.50	125.37	10.43
I1	R	5.97	-	-	-	-
I2	R	6.46	-	-	-	-

from which the child recovered. The first two events probably had occurred around 12th to 18th month of age, and the last one a couple of months prior to the death. The fourth event was too serious, proving fatal.

Since the dentition of the sub-adult specimen is in a developing state, minute reading of the status of crown and root development could be recorded, which helped accurate estimation of the age at death (Tables 7-8).

Interestingly there are two hypoplastic defects on maxillary left Dc. The crown calcification of deciduous canine begins at the 5th month in uteri and is complete by the 9th month. The two stress episodes which caused deficient enamel formation are not related to the stress event depicted by the Harris lines. The enamel calcification disturbance is an earlier event probably at the time of birth itself, or in the first few months of life.

The crown calcification and root formation status suggest the age of around 2 years at the time of death. Sex cannot be determined for this individual.

Concluding Comments

The Abhaipur human skeletal series is important in many ways. It is the only evidence from the PGW levels so far systematically studied. The excellent preservation of the adult skeleton provides a rare opportunity for in-depth anthropological scrutiny. The rare morphological traits like open metopic suture, presence of wormion bone, open spinous process and absence of one vertebra, can be congnial in origin. Many of them have been noticed for the first time in Indian protohistoric context.

Many protohistoric sites in India provide human skeletal evidence, but there are seldom enough for drawing a population demographic profile or few comparative

Table 8: Abhaipur sub-adult: dental development, morphology and pathology

Tooth	Side	Crown Calcification	Root formation	Attrition status	Age estimation	Morphology	Pathology
Maxilla							
Di1	R	Complete	Complete	Grade 1	More than 1.5 years	Shovelling Grade 2 (?)	Pinkish colouration on the buccal side. Fluorosis (?)
	L	Complete	Complete	Grade 1	More than 1.5 years	Shovelling Grade 2 (?)	Pinkish colouration on the buccal side. Fluorosis (?)
Di2	R	Complete	Root tip not complete yet	Grade 1	Around 2 years	Shovelling Grade 1 (?)	Pinkish colouration on the buccal side. Fluorosis (?)
	L	Complete	Root tip not complete yet	Grade 1	Around 2 years	Shovelling Grade 1 (?)	Pinkish colouration on the buccal side. Fluorosis (?)
Dc	L	Complete, fully erupted	Root half complete	-	Around 2 years	-	Pinkish colouration on the buccal side. Fluorosis (?) Hypoplastic pits on buccal (CEJ distance 1.47 mm) and mesio-lingual side (close to CEJ line).
Dm1	L	Complete	Broken tips, almost complete?	Grade 1	Around 2 years	-	Pinkish colouration on the buccal side. Fluorosis (?)
Dm2	R	Complete, tooth erupted	Half complete	Grade 0	Around 2 years	-	Two small capsules between cusp 1 & 2. One small nodule on the mesial side Pinkish colouration on the lingual and distal side. Fluorosis (?)
I1	L	Half complete	Not yet formed	-	Around 2 years	-	-
M1	R	Almost complete	Not yet formed	-	Around 2 years	Hypocone grade 3, Metacone grade 5	-

Tooth	Side	Crown Calcification	Root formation	Attrition status	Age estimation	Morphology
Mandible						
Di1	R	Complete	Complete	Grade 0	More than 1.5 years	-
	L	Complete	Complete	Grade 0	More than 1.5 years	-
Di2	R	Complete	Almost complete	Grade 0	Around 2 years	-
	L	Complete	Almost complete	Grade 0	Around 2 years	-
Dc	L	Complete	Half complete	Grade 0	Around 2 years	-
Dm1	L	Complete	Almost complete tips incomplete	Grade 1	Around 2 years	-
Dm2	L	Complete, tooth erupted	Half complete	Grade 0	Around 2 years	Y–5 groovecusp pattern
I1	R	Half complete	Yet to be formed	-	Around 2 years	-
I2	R	Half complete	Yet to be formed	-	Around 2 years	-

Note: The dentition is immature. Many teeth have pinkish coloration, presumably because of young age, which is not likely to be dental fluorosis.

studies. Sites like Abhaipur should be excavated on a larger scale, to examine cultural associations of the specimens in the PGW levels.

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On the Continuity of Engineering Tradition from the Harappan to Ganga Civilization

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Abstract

The transmittance of Harappan engineering standard of length measure to the Gupta period has been confirmed by analysis of the dimensions of the Delhi Iron Pillar utilizing the basic Harappan unit of measurement of 17.63 mm. This unit of measurement – the angulam proposed by Danino - is confirmed based on material evidences from the Harappan Civilization (Kalibangan terracotta scale) and Ganga Civilization (Delhi Iron Pillar).

Introduction

There is a growing body of evidence that Harappan techniques, crafts, ornaments, art forms, customs, rituals and religious beliefs were transmitted virtually unchanged from the Harappan civilization to the Ganga civilization (Kenoyer 1998, Lal 2002). The Harappan Civilization (3000-1600 B.C.) included major centres at Mohenjodaro, Harappa, Lothal, Dholavira and Kalibangan while the Ganga Civilization represents the settlement along the Ganga plains from about 800 B.C. The importance of the discovery of carburization of iron (i.e steels) in the clearing of the dense forests along the Ganga plains is now understood (Balasubramaniam 2007). A direct consequence of urbanization is the engineering skill that is required to create a surplus economy and maintain elaborate settlements. It is important to realize that such engineering activities must have required the use of engineering tools for measurement for weights, length and time. The use of such tools implies the utilization of standard units of measurement. It is now well known that the Harappan Civilization used standard weights and measures (Agrawal 2007). Engineering instruments related to length, weight and time are available in some of the Harappan sites (Joshi 2008). This communication will address the continuity of engineering tradition as related to units of measurement of length, from the Harappan Civilization down to the Ganga Civilization, based on material evidence.

The Harappan Unit of Length Measurement

It is evident that the Harappans possessed a good idea of geometrical principles as revealed by their intricate town planning and use of specific units of measurement. For example, the standardization of length measurement is evident from the standard manner in which most of the bricks in the Mature phase (and occasionally in the Early phase) follow ratios of 1:2:4 in terms of height-width-length, with the dominating size being 7 x 14 x 28 cm (Kenoyer 1998: 57 and Rottländer 1983: 202). These dimensions can be elegantly expressed as 4 x 8 x 16 *angulams*, with the unit of *angulam* taken as 17.63 mm. Danino (2005, 2008) has proved that the basic unit of measurement of the Harappan Civilization is 17.63 mm, after a detailed and thorough statistical analysis of available length measurements of several Harappan settlements. Further, 108 *angulam* make one *dhanus* (108 *angulams* = 1.904 m). Danino (2005, 2008) has demonstrated, through a simple procedure and with no *a priori* assumption, that this value of *dhanus* will result in all the dimensions of the important Harappan settlement of Dholavira expressed as integral multiples of *dhanus*. It is interesting to note that the number 108 is held sacred in classical Hinduism, primarily because of astronomical reasons (Kak 2000).

Some interesting objects related to engineering were discovered at Kalibangan (Joshi 2008). Notable among them were a crude terracotta length scale, a terracotta hour glass, plumb bobs, terracotta pans for balances and several weights. These objects have been described, with their dimensions and weights, in the excavation report (Joshi 2008). The terracotta hour-glass appears to have been used for the purpose of time keeping. The plumb bobs were of terracotta, faience and shell. As regards the weight, they were of chert and agate.

This correspondence will first analyse the terracotta linear scale discovered at Kalibangan in order to obtain further insights on the basic unit of measure of the Harappan civilization. The terracotta scale appears to be a relatively inexpensive measuring instrument, based on it's raw material. Scales made of ivory, metal or shell would have been relatively more expensive.

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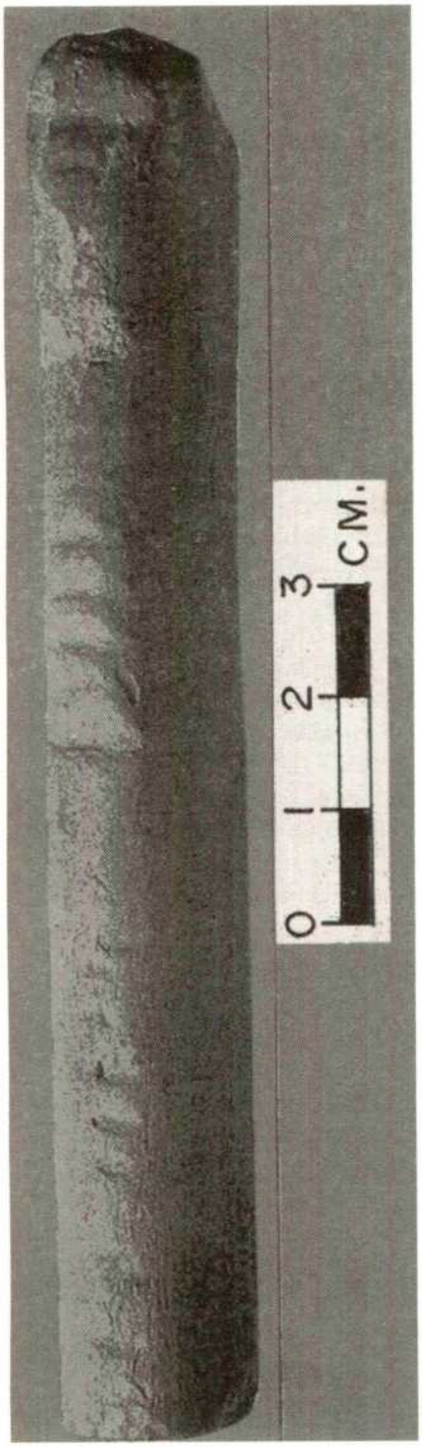

Fig. 1: Terracotta scale discovered at Kalibangan (photograph courtesy: J.P. Joshi)

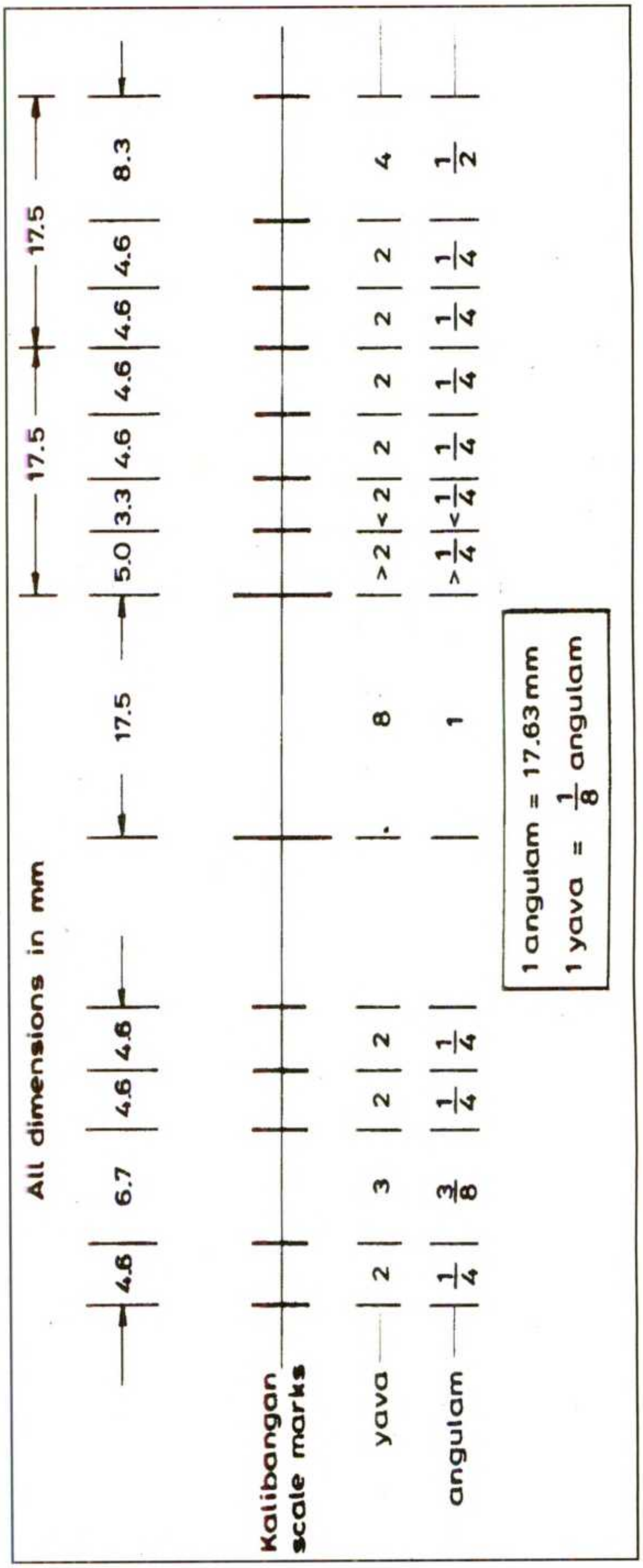

Fig. 2: Technical analysis of dimensions of the Kalibangan terracotta scale

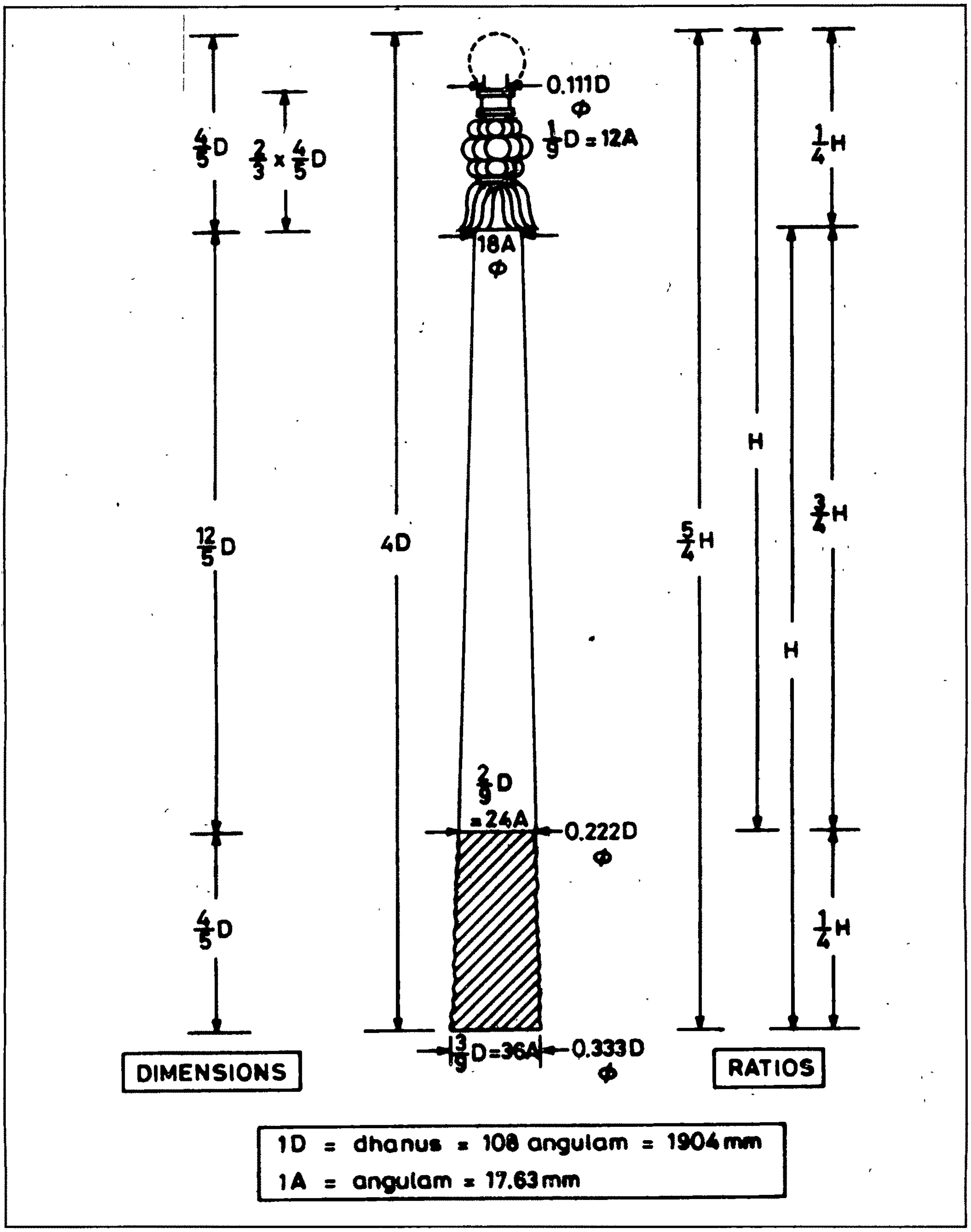

Fig. 3: Dimensions of the Delhi Iron Pillar analyzed in terms of *angulam* (= 17.63 mm) and *dhanus* (= 108 angulams = 1904 mm). The significant ratios that are evident in the Iron Pillar's relative dimensions are mentioned on the right.

The total length of the Kalibangan terracotta scale is 12.2 cm (see Fig. 1). The scale is damaged on both sides. It appeared to be slightly tapered. It has a maximum diameter of 12 mm. The distances between the markings on the scale have been measured and the dimensions are shown in Fig. 2. The marking on the scale can be described as follows. The measured distance between two major tick marks is 17.5 mm. Of the minor tick marks on the right, four together make up 17.5 mm. Therefore, each minor tick mark on the Kalibangan scale corresponds to one fourth of the major tick mark.

The markings in the Kalibangan scale approach the 17.5 mm standard that is also noticed in Lothal (ivory) (Rao 1955-62) and Mohenjodaro (shell) (Mackay 1938) scales. Moreover, the direct connection between this standard unit and the unit in the Harappan (metal) (Vats 1940) scale is established (Mainkar 1984). The major tick mark is indicative of the *angulam* which was equal to 17.63 mm as proposed by Danino (2005, 2008). The markings on the Kalibangan scale have been discussed in more detail elsewhere (Balasubramaniam and Joshi 2008).

It is *important* to note that the unit of 17.5 mm was obtained precisely in the Kalibangan scale. It is likely that the measurement when marked on the unbaked clay would have contracted on shrinking due to the firing operation. This appears to have been taken into account in the design of the scale. The remarkable closeness of the Kalibangan scale to the Harappan units obtained from the Lothal (Rao 1955-62) and Mohenjodaro (Mackay 1938) scales is striking.

The Kalibangan terracotta scale offers conclusive proof that the basic Harappan unit of measurement was 17.63 mm. The proposal of Danino (2005, 2008) is confirmed by this material evidence. It is important to now explore how this unit of length measurement was transmitted through time. Therefore, this unit of will be related to a significant historical monument to understand the co-relation, if any, between the Harappan unit of measurement with the unit of measurement of the historical monument.

The Gupta Period Unit of Length Measurement

One of the significant historical monuments of the Indian subcontinent is the Delhi Iron Pillar (Anantharaman 1996; Balasubramaniam 2002, 2005). It is also well established that this Iron Pillar belongs to the Gupta period (320-600 A.D.). Since the Delhi Iron Pillar is truly a significant engineering achievement of this golden period in Indian history, it would be interesting to explore the dimensions of the pillar in light of the available new data that the traditional unit of measurement, the *angulam*, is 17.63 mm.

The dimensions of the Delhi Iron Pillar have been measured in great detail by Beglar (1874) and Ghosh (1963). The available dimensions were analyzed earlier by Balasubramaniam (1997) to show the inherent symmetry in the design of the pillar, by considering the base rough buried underground during its original erection at Udayagiri. The relative proportion of the various parts of the pillar was also studied. The decorative bell capital is 1/3rd of the cylindrical portion of the pillar above the ground, and 1/4th of the total height of the pillar above the ground. The height of the decorative bell capital is also equal to the depth of burial below the ground. When the overall dimensions of the pillar were analyzed (Balasubramaniam 1997), it was pointed out that one could relate the Iron pillar's dimensions to the unit of the modern inch which was called U. The modern inch is equal to 25.40 mm.

Considering the traditional Indian *angulam* to be 17.63 mm and that 108 *angulams* made a *dhanus* (i.e. 108 x 17.63 mm = 1904 mm), and the known dimensions of the pillar (Beglar 1874, Ghosh 1963), the dimensions of the latter can be converted into units of *angulam* (A) and *dhanus* (D). This has been performed and the end result is shown in Fig. 3.

The striking feature of the analysis is that the pillar's dimensions remarkably matches units of *angulam* and *dhanus* of the Harappan civilization. For example, the total height of the pillar is 4 *dhanus*. The mathematical significance of the measured dimensions and the discernable ratios (see Fig. 3) has been explored in great detail elsewhere (Balasubramaniam 2008). The errors between the theoretical and actual measurements were, remarkably, very low (Balasubramaniam 2008).

It is indeed fascinating that the unit of measurement that was used in the planning of Harappan civilization settlements are also realized in the dimensions of the Delhi Iron Pillar, thereby establishing the continuity of scientific ideas and traditions from the Harappan civilization (3000 - 1600 B.C.) down to later periods in Indian history, certainly at least up to the Gupta period (320-600 A.D.). Considering Dholavira's date from the Mature Harappan period of 2000 B.C. and the date of the Iron Pillar of 400 A.D., this implies an almost continuous unbroken tradition stretching more than 2400 years.

Conclusion

The transmission of the engineering standard unit of length measurement in an unchanged form from the Harappan civilization to the Ganga civilization, is confirmed by material evidence presented in this study, viz. the Kalibangan terracotta scale and the Delhi Iron Pillar.

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Narrating State in Early Historic Bengal

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Abstract

The discovery of a large number of archaeological remains such as coins, potsherds and other antiquities from West Bengal and Bangladesh clearly illustrates the rich heritage of this region. Recent research has revealed new light on this region, although many questions related to the State during the Early Historic period in Bengal remain unanswered. This paper examines the formation and nature of the State after considering available archaeological, numismatic, epigraphic and literary sources. It traces the evolution of the State in the lineage-based society of the pre-Mauryan era, the implantation of a Kautilyan state model from the Middle Ganga Valley in the Mauryan era, and the influence of the Kushanas' model during the post-Mauryan era.

Introduction

The evolution and formation of a state in the history of a society is an intricate and dynamic process. It would be perhaps fallacious to attempt to locate one factor that brings about the transformation from a pre-state society, through amorphous proto-state formations to a definitive and distinct state apparatus. Numerous factors may be crucial and apply differently in varying situations. Amongst these, technology (with irrigation as one of the major causative factors), ecological context, population growth, social circumscription, and increasing social heterogeneity leading to social stratification, are all seen as major variables. This study of the process of evolution and formation of a state in Bengal during the Early Historic period departs from the all-pervading obsession with Oriental Despotism, derived from the colonial legacy, with its variant, the Asiatic Mode of Production. It is also necessary to point out that any endeavour in reconstruction of Early Historic Bengal is bound to be handicapped by paucity of material evidence. The most thoroughly researched works such as those of Majumdar (1943), and Niharranjan Ray (1994) also have this problem.

It is necessary to define two key notions: state and lineage. For the purpose of this study, a lineage is identified as "a corporate group of unilineal kin with a formalized system of authority" (Thapar 1990: 10). The term used here in preference to the more commonly used 'tribe', "emphasizes the centrality of lineage in all its aspects which is of the essence of such a society, particularly in relation to power and access to resources" (Thapar 1990: 18). In a lineage system, several unilineal descent groups constitute a clan and its basic unit "is the extended family based on three or four generation lineage controlled by the eldest male who represents it on both ritual and political occasions" (Thapar 1990: 10).

In contrast, four major traits of varying importance are indispensable for the identification of a state – substantiation of functional political authority extending over a clearly demarcated territory, authority designated to functionaries, financed by revenue contributed regularly for its functioning and "it acts as an instrument for integrating social segments identified not merely by ritual roles but also by economic functions" (Thapar 1990: 11).

The Study Area

Although 'Bengal' is politically non-existent today, almost all of it lay within the geo-political entities that are currently known as Bangladesh and West Bengal (20° 50' and 27° 09' N to 86° 35' and 92° 30' E) (Fig. 1). It should be noted that the entire area delineated above does not constitute ancient Bengal. In a recent study, Islam (2001) used pollen analysis to establish the Holocene history of relative sea level changes. He indicated that since c. 7000 BP the shoreline of the Bengal Delta (from the Sundarban region to the Padma-Meghna course) was moving uniformly in a southeast direction. During early mid-Holocene (7000 to 4000 BP), the sea was further inland. The site of the city of Khulna was then under the sea and the coastline was very close to the sites of Jessore and Narail. The northern limit of the present-day Sundarbans was established (with some local variation) at c. 3000 BP and the sea finally retreated from the Khulna region at

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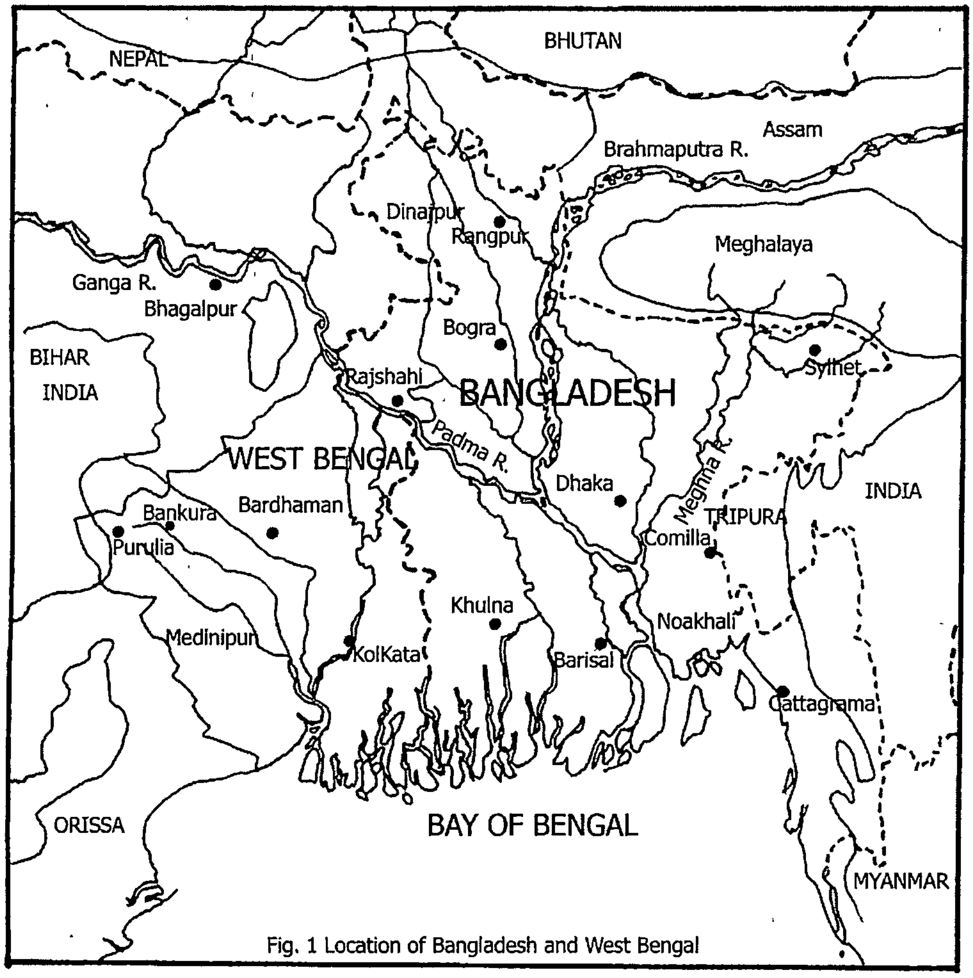

Fig. 1: Map of Bangladesh and West Bengal

about 1800 BP (Islam 2001: 138-139). On the other hand, Matuail (3 km east of Dhaka city) was under the influence of sea level changes until about 2400 BP. From 7000-4000 BP, the funnel shaped mouth of the Bay was possibly much wider than today and Dhaka and the surrounding regions were then at the head of the Bay (Islam 2001: 142). The estuary of the Brahmaputra and the Meghna, even in historic times, was near their present confluence at Bhairab (Islam 2001: 144). Citing historical records Islam (2001: 139) further indicates that the Bengal Delta has not grown seaward significantly during the last 200 years. In a separate study on the eastern coast, Monsur and Kamal (1994: 19-20) have shown that during the maximum high stand of sea level (some 6000 years BP), sea waves washed the foot of the hills from Cox's Bazar to Teknaf and St. Martin's Island was under the sea. In other words, there has been very little progradation of the coastline along the Chittagong coast since 6000 years BP.

This study proceeds in three stages. The first stage is an attempt to trace the earliest formalized system of authority during the pre-Mauryan era (upon which mechanisms of state evolved in later periods). The second phase includes narrating the development of state during the Mauryan period. The third stage examines the history of Bengal during the post-Mauryan period.

Pre-Mauryan Era

As the efficiency of agricultural production was enhanced during the Neolithic period, it was possible for farmers to generate surplus food. The improved mode of food-procurement brought about a noticeable change in the material culture of the inhabitants. As a result, a section of the population was freed from the task of food procurement and was able to divert their talent to crafts such as pottery, carpentry, weaving, basket-making, stone quarrying, brick making and masonry. Subsequently, other occupational groups such as oil pressers, washermen, barbers, musicians, dancers and priests also emerged. The point not to be missed is that the generation of agricultural wealth and appearance of distinct occupational groups in the Neolithic period transformed the egalitarian hunting-gathering society of the Paleolithic period into a society divided into the rich and the poor, the exploiters and the exploited.

Archaeological materials at hand are of little help to make further inferences regarding the authority structure of the pre-Mauryan era. The *Mahabharata*, is traditionally believed to refer to events approximately in the 14th century B.C., recounts a story of five sons (Anga, Vanga, Kalinga, Pundra and Suhma) of a blind old sage named Dirghatamasa (*Mahabharata*, Adiparva, Section 104). It is possible that the descendants of those "five sons", i.e., five corporate groups of unilineal kin with a formalized system of authority, whom the *Mahabharata* identifies as the "Mlechchha tribes" of the Eastern Region.

The *Mahabharata* also observes that "Vasudeva the king of the Pundras, and the kings of Vanga and Kalinga" were present in Yudhishthira's Rajasuya Sacrifice (*Mahabhrata*, Sabha Parva, Section XXXIII; Ganguli 1990: 71). The implied meaning is clear; the kings of the Eastern Region were all clan-chiefs of various magnitude but none of them had the authority as exalted as that of Yudhishthira, who alone could perform the Rajasuya series of rituals of the royal consecration. By extension, it is also implied that a lineage system of authority with a king endowed with a divine charisma at its apex, as in the case of Kuru Janapada, was yet to develop in Bengal. If we superimpose these fragmentary images of Bengal derived from *Mahabharata*, on the material evidences provided by archaeological excavations, we note that the pre-Mauryan era saw generation of agricultural wealth, appearance of distinct occupational groups and a society divided into the rich and the poor. Thus, the "tributes and various kinds of wealth" that Bhima received from the "Mlechchha tribes" become significant tangible aspects of culture of this period:- "sandal wood, and aloes, and clothes and gems, and pearls and blankets and gold and silver and valuable corals" (*Mahabharata*, Sabha Parva, Section XXIX; Ganguli 1990: 61-62). Sandalwood, aloe, pearl and valuable corals were possibly obtained by hunter-gatherers, while textiles, blankets, gems, gold and silver must have been produced by craftsmen of the period. These were some of the most valuable produce of pre-Mauryan Bengal.

Charred grains of rice and husk-impressed pottery were found at excavated sites at Mahisdal in Birbhum and Padu Rajar Dhibi, Bharatpur and Baneswar Danga in Bardhaman district. Rice husk was also found within ceramic cores and as a constituent in making house floors at Mangalkot in Bardhaman district. This indicates that the Chalcolithic culture produced rice and was riparian in nature. The analysis of animal bones found at Chalcolithic sites reveals that sheep, goat, buffalo and pig were common domestic animals. Rice was consumed along with fish, tortoise, bird, pork, venison and turtle-fish as indicated by a large number of bones of these species found in habitation layers. They also revolutionized the transportation system by making use of wheeled vehicles pulled by domesticated animals. The houses of the period were simple rectangular huts, the walls of which were made of reed screens plastered with mud; and the floor (at least in some cases) was made of bedding of gravel and cobble rammed in hard silty clay. The religion of the Chalcolithic people is may have been centred around the worship of the mother goddess as indicated by the finding of such figurines at Mangalkot.

Material evidence clearly indicates that southwestern Bengal, comprising the districts of Murshidabad, Birbhum, Bardhaman, Bankura and Medinipur in West Bengal, made a significant advancement, both socially and economically, between 1450 and 900 B.C. Crafts related to the life-style of Chalcolithic people imply the existence of a wide variety of specialization of occupation and division of labour. We may also believe that a society that has a range of specialized craft-persons would also have a group of traders to facilitate exchange. They may have been petty traders and their circuit may have been limited. There must also have existed centres of exchange where traders, cultivators and specialist craftsmen congregated to exchange commodities. These factors could have led to the formation of hierarchical economic organization and a stratified society.

In order to maintain social and economic systems as complex as suggested, there must have existed a highly formalized system of authority. A clear indication that the system of authority was lineage-based is provided by material evidence obtained from Mangalkot, where remains of three superimposed floors of a house have been found. Clearly, the three succeeding floors indicate hereditary succession. It is not possible to make further inferences regarding the nature of the authority system till further evidence is made available. Nevertheless, if we take the *Aitareya Brahmana* and the *Aitareya Aranyaka* (composed c. 9th century B.C.) into account, it is possible to suggest that the authority system in Suhma was possibly more sophisticated than that of the neighbouring Pundras. The latter are disparagingly referred to in the *Aitareya Brahmana* as 'dasyus', while the Vangas, are referred to as heathen and willful and speakers of a language like that of the birds, in the *Aitareya Aranyaka*. This difference between Suhma on the one hand and the Pundra and Vanga on the other, must surely be based on differences in the level of technological achievement. The authority system in Pundra and Vanga may have remained somewhat similar to that of the clan-chief Vasudeva, mentioned in the *Mahabharata*. Owing to the prevailing Chalcolithic culture and consequent development of a hierarchical economic organization and a stratified society, the system at Suhma, may have had given rise to a proto-state formation. As we shall see, this part of Bengal witnessed the earliest state formation.

The technology of iron was introduced into Uttara Radha and Dakshina Radha or the Suhma region during the late phase of the Chalcolithic culture from the end of the 8th century B.C. as seen at the sites Pandu Rajar Dhibi, Chandraketugarh, Mangalkot, Bahiri, Bharatpur, Dihar, Pakharna, Tamluk and Tulsipur. The introduction of iron technology must have been a boon for the people of this region. As compared to the scanty copper deposits, iron was (and still is) locally available in the districts of Purulia, Bankura and Bardhaman. The districts of Medinipur, Birbhum, Bankura and Bardhaman also possessed sources of low-grade iron. Further, iron deposits are abundant in the Chota Nagpur region. The inhabitants of Pandu Rajar Dhibi had knowledge of iron smelting around 705 B.C. as seen by the radiocarbon dates available. However, the knowledge of quenching and tempering techniques that are necessary for producing steel appears to have been introduced into Pandu Rajar Dhibi much later, i.e. in the 3rd century B.C. Iron artefacts including points, crucible, sickle, sword, spearhead, as also a furnace along with a fragmentary iron implements and iron slag were found at the site. The recovery of an iron sickle from the site indicates an improvement in agricultural techniques and increased output.

The introduction of iron technology was also of crucial importance to the expansion of settled life and accentuated the growth of various occupational groups such as smiths, carpenters, agriculturalists, makers of bone objects, workers of semiprecious stone beads, and potters. With the help of iron tools, enterprising farmers cleared the dense forests of the sub-humid plains of the lower Ganga valley. As Kosambi (1975: 149) reminds us, even in 600 B.C. "Bengal was covered by a dense, swampy forest" This brought about effective human colonization of this vast fertile region. This evidence clearly indicates further development from a hierarchical economic organization and stratified society that we observed in the Chalcolithic period.

It is no wonder that during Alexander's invasion of South Asia (c. 327-325 B.C.), there was a powerful kingdom named Gangaridai with a clearly articulated state. Ptolemy (mid 2nd century A.D.) in his *Geography*, locates Gangaridai as "all the country about the mouths of the Ganges" and identifies its capital as Gangê (Book VII, Cap. 1, 81).

Gangê is also mentioned in the *Periplus* as an important seat of commerce on the river Ganga and has been identified as an ancient maritime port (Jahan 2004). Interestingly, Curtius leads one to believe that there were two separate kingdoms called Gangaridas and Prasios (Prasii) and that sometime in the 3rd quarter of the 4th century B.C., they were united under one king. Similarly, Plutarch speaks of "the kings of Gangaridai and the Prasoi" but later speaks as though there was only one king and one kingdom (Ray 1993: 355). These references prompted Ray (1994: 297) to argue that before Alexander's invasion, Gangaridai and Prasii "were independent states" but merged as one around the third quarter of the fourth century B.C. It is clear from historical evidence that Vanga and Radha (Suhma) emerged as clearly articulated kingdom states somewhere in the 5th century B.C. These kingdoms were brought under one state before the reign of Mahapadma Nanda.

Mauryan Era

The authority of the Mauryas (c. 324 to 187 B.C.) was acknowledged in Pundravardhana, Radha-Suhma and Vanga in the 3rd century B.C. This is proved by the Mahasthan stone inscription, the discovery of a large number of Northern Black Polished Ware (the chronology of which in the eastern parts of South Asia has been ascertained between c. 300 B.C. and 100 A.D.; Chakrabarti 1992: 178), and imperial series of punch-marked coins at Mahasthangarh and Wari-Bateshwar in Bangladesh (Fig. 2) and Bangarh, Chandraketugarh and Tamluk in West Bengal, India. The Mauryan state was composed of different tiers of political structures, namely, the metropolitan state, the core territory and peripheries. It is also necessary to remember that 'Bengal' during this period was a landmass bordered by the vast Brahmaputra in the east. The river flowed through its old channel and its confluence with the Meghna was near Bhairab. Dhaka and the surrounding regions were then at the head of the Bay and the sea had just retreated from the Khulna region (Islam 2001: 138-144). With these factors in mind, the following description attempts to piece together the character of the state during the Mauryan era.

The geographical location of Pundravardhana, Radha-Suhma and Vanga make it likely that these geographical units were incorporated into the eastern province of the

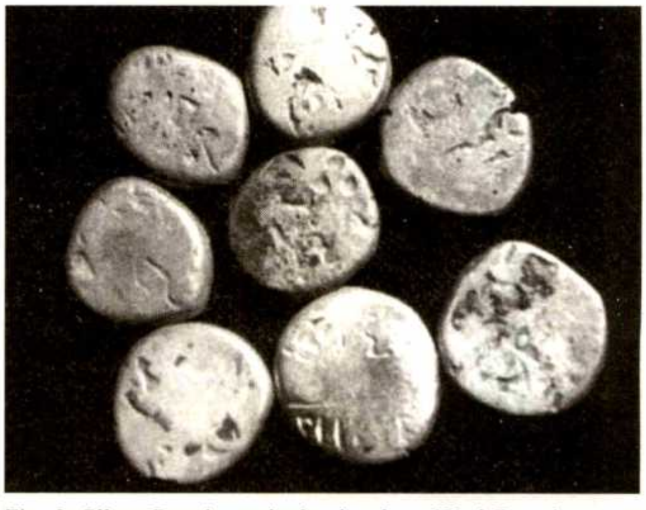

Fig. 2: Silver Punch-marked coins from Wari-Bateshwar

Mauryan Empire of which Tosali was the capital. If we assume that Tosali was the site currently known as Sisupalgarh in Orissa, (as one of the two Kalinga rock edicts addressed to the Mahamatras of Tosali appears to imply), then it is possible that Mahasthangarh and Wari-Bateshwar (Bangladesh), Bangarh and Chandraketugarh (West Bengal, India), all fortified cities of this era, were centres of *Vishaya* or *Ahara* administration. These, along with a few other unidentified areas constituted the core of the empire. It is not unlikely that a sizeable portion of Pundravardhana and large tract of Radha-Suhma and Vanga constituted peripheral territory where the Mauryan state enforced its dictates through pre-Mauryan ruling elites.

The Mahasthan stone inscription (now held by the Indian Museum Kolkata and palaeographically datable to the first half of the 2nd century B.C., Dani 1963: 57) gives some indication of how the political system of the Mauryas in Pundranagara (the centre of Pundravardhana) functioned in times of crisis such as famine. After being incorporated into Maurya territory, the iron mines of Radha-Suhma region went directly under state control. It also "controlled access to resources, particularly the forests, which permitted control of both timber and animal wealth as well as clearance of land for cultivation" (Thapar 1990: 123). Consequently, the Mauryan state "became the central land clearing agency with the objective of extending settled agriculture and breaking up the disintegrating remnants of the frontier hill tribes whose members could serve as a useful source of providing labourer-cultivators on these newly cleared forest lands" (Birodkar 2006). Because major tracts of Pundravardhana, Radha-Suhma and Vanga at this time was forest land, we believe that the state apparatus in these regions played a similar role, which, in effect, would only have been a continuation of the forest clearing vigour that we had seen developing in the Iron Age. Mauryan initiative had a double-pronged effect. On the one hand, the clearing of the forest opened further contact with Neolithic inhabitants, who were influenced by the dominant culture. This in turn generated the process of disintegration of Neolithic culture and brought these people within the ambit of the state. This not only added value to the state revenue system but also led to further land-clearing and settled agriculture. The land reclaimed largely with the labour of displaced Neolithic inhabitants, was known as *sita*, which was one of the two major types of landholdings under the Mauryan state. It is very likely that the lifestyle of the inhabitants of Pundravardhana, who were introduced to iron in the 3rd century B.C., were systematically annihilated by the Mauryan state as a result of land-clearing activities. A similar process albeit on a smaller scale may have significantly erased the remnant pre-historic cultures from Vanga and Radha-Suhma.

Prehistoric cultures gradually but surely began to disappear from Pundravardhana, Radha-Suhma and Vanga; and *sita* landholdings began to appear in as a result of forest-clearing. Thus, the landholdings of the pre-Mauryan lineage chiefs and their functionaries who were subjugated by the Mauryas, were accommodated within the revenue system as *rashtra* landholdings. To a considerable extent, these holdings were "independent of the state machinery in their internal functioning and administration. Their only obligation was the regular payment of the *rashtra* taxes to the state" (Birodkar 2006). It is likely that the state also encouraged surplus settlers from the overpopulated area of the Ganga valley, who were familiar with the technique of transplanting paddy since the 5th century B.C., to settle on *sita* landholdings along the Bhagirathi-Hugli in Radha and Vanga, and the Karatoya and the Atrai in Pundravardhana. These settlers may have significantly contributed to the introduction of wet rice cultivation in particular and the spread of agriculture in general.

The *Arthasastra* (1.4.1) recognizes *vanijya* (trade) as one of the three principal vocations, the others being *krsi* or agriculture, which was the most important; and *pasupalya* or cattle-tending (Kangle 1963: 10 and 1965: 166-167). There is considerable evidence to believe this and state that Radha-Suhma, Vanga and Pundravardhana maintained a flourishing trade in commodities controlled by affluent merchants and traders. This was based on a recognized media of exchange as is clear from the discovery of punch marked coins in silver, copper and bullion and cast copper coins from various urban sites in Pundravardhana, Radha, Suhma and in the south-westernmost area of Vanga. This factor extended the geographical reach of trade as also the range of items traded and led increasingly to the computation of wealth in the form of coins. Among the economic innovations associated with coined money which were to have far-reaching effects in the social life of the times, was the introduction of the profession of money lending and banking. As an extension of this profession, activities associated with further speculation also arose. The distribution of punch-marked coins provides a clear indication of trade links of the era.

A well-connected network of land and riverine routes facilitated internal trade. It has also been established that during this era, Tamralipti (in Radha-Suhma), Gangabandar (in Vanga) and Wari-Bateshwar (in Pundravardhana) emerged as an important commercial centre. Industry was well developed in Radha-Suhma, Vanga and Pundravardhana and was classified into private and public sectors. It has been suggested that the state owned warehouses and shipyards, and undertook large-scale commodity production, so much so that it is believed to have been "far the biggest owner of the means of production and organiser of the normal economic functioning" (Birodkar 2006). However, we have no way of ascertaining the validity of this claim beyond Kautilya's *Arthasastra*. The distribution pattern of the Northern Black

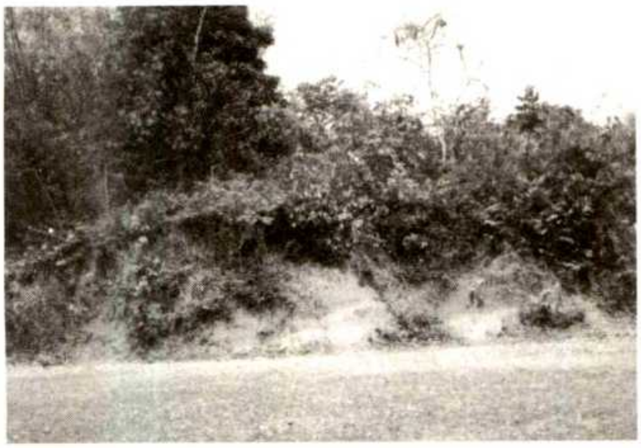

Fig. 3: Southern wing of the earthen rampart of the Bateshwar Fort

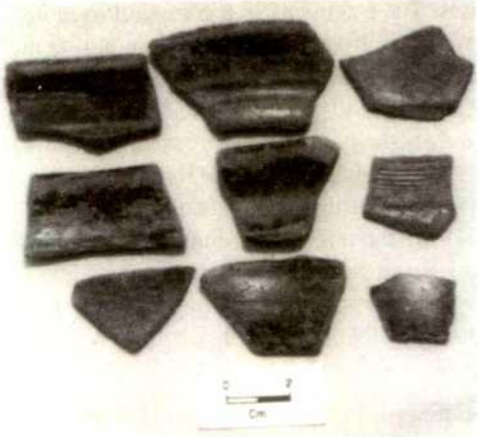

Fig. 4: Northern Black Polished Ware from Wari-Bateshwar

Polished Ware, semiprecious stone beads, glass beads and other related artefacts are evidence of a well established trade network between Radha-Suhma, Vanga and Pundravardhana on the one hand, and the middle Ganga Valley, Orissa, south east India and Sri Lanka on the other. Commodities involved in trade included metal (iron, copper, tin, lead and silver), ivory, various types of pottery, semiprecious stone beads, glass beads, textiles, etc. This process would have involved skilled craftsmen in urban centres or villages, procuring raw materials, producing commodities and selling them in market towns. The three commercial centres mentioned above also served as maritime ports, which were well-connected with major ports in South Asia and Southeast Asia (Jahan 2002 and 2006).

The *durga* (fort, which is sometimes also referred to as the *pura* or the fortified settlement) is the fourth 'limb' of the state in Kautilya's *Arthasastra.* Whether referred to as *durga* or *pura*, the term signifies a defence-cum-administrative centre together with a treasury and districts inhabited by artisans and guilds. Undoubtedly, these were major cities, which had both a political and commercial base (Thapar 1990: 121). We have sound reason to believe that such fortified administrative centres-cum-cities flourished in Radha-Suhma, Vanga and Pundravardhana because sites such as Mahasthangarh, Wari- Bateshwar (Fig. 3), Bangarh and Chandraketugarh have been found enclosed by remnants of earthen ramparts. Further, Northern Black Polished Ware has been found at all these sites (Fig. 4). The distribution of the ware shows that they were available at all urban centers of South Asia. As the chronology of NBPW in the eastern parts of South Asia has been ascertained to be between c. 300 B.C. and 100 A.D. (Chakrabarti 1992: 178), we may safely believe that the presence of the ware in the sites mentioned above indicates the rise of urban centers and diffusion of Indo-Aryan culture during the Mauryan era. Judging by the size of settlements, all cities, i.e., Mahasthangarh, Wari-Bateshwar, Bangarh and Chandraketugarh, were quite large. The presence of earthen ramparts enclosing cities indicates that they also functioned as administrative centers, most probably headquarters of *vishayas*. The Mahasthan inscription is the only available document that allows one to imagine how these *vishaya* headquarters operated.

The fifth 'limb' of the state in the *Arthasastra* is the *kosa* or the treasury, where the revenue was gathered after collection. The state obtained enormous surplus by "an unprecedented expansion of economic activity by the state", which resulted because of "state control of agriculture, industry and trade" and monopoly control over mining and in trading of salt, liquor and minerals (Thapar 1966: 84.). Public expenditure was not executed without prudence. Kautilya suggested that the treasury should maintain enough reserve to tide over lean period (Thapar 1990: 121-122). Evidently, this bit of advice was followed in Mahasthangarh under the Mauryas because the inscription cited above not only indicates the presence of a treasury at the site, but also that the treasury was able to loan money to the distressed during a lean period.

Post-Mauryan 'Interregnum'

The political history of the various geographical units of Bengal during the post-Mauryan era (c. 186 B.C.- 320 A.D.) is poorly understood. The Sunga Empire, established after the fall of the Mauryas, exerted control over north-central and eastern parts of South Asia from c. 185 to 73 B.C. with Pataliputra as its capital. Though terracotta figurines have been found at Mahasthan, Bangarh, Dihar, Chandraketugarh and Tamluk. However, we are uncertain as to the exact nature of Sunga control over these geographical units. The fragments of a colossal image in sandstone discovered at Silua (16 km to the south of Feni, in the Cattagrama hill tracts), which was assigned to the 2nd century B.C. (*Archaeological Survey of India* 1930-34, part 1: 38-39), may actually have been from the medieval period as Chakrabarti (1992: 61) argues. Hence it cannot be cited as an evidence for the reconstruction of political history Bengal during the reign of the Sungas. The Kanvas replaced the Sungas and ruled in the eastern part of South Asia from 71 to 26 B.C. As Magadha was the core of their domain, it is not impossible that Pundravardhana was also under their control.

As it has been argued elsewhere (Jahan 2002 and 2006), 'Bengal's' maritime trade reached unprecedented heights during this era, a fact which remained unmatched in the Gupta and the post-Gupta eras. Archaeological findings from explorations and excavations in Chandraketugarh, Tamluk and the neighbouring regions amply support this observation.

The discovery of a large number of pre-Kushana cast copper coins, imitation-Kushana, Kushano-Radha and Kushano-Vanga coins from Radha, Suhma and Vanga clearly indicate the circulation of coined money in the post-Mauryan era. It is likely that between the 1st and the 3rd centuries A.D., one or more states and not guilds issued these coins because their distribution is spread over a large territory that includes western part of Vanga, Radha and Suhma. The coins signify high levels of economic activities extending to petty transactions (since low denomination coins have also been found). They also indicate that the authorities issuing coins had the confidence of the people. The state/s issued coins in imitation of the Kushana copper possibly in order to facilitate trade with the Kushana Empire (c. 1st–3rd centuries) and because it/they maintained close links at the political level. As the domain of the Kushanas at their height of glory (about 105–250 A.D.) extended into the Ganga valley in northern India, the state/s under review lay immediately to the east of the empire's eastern frontier.

At this point one may consider Ptolemy's evidence and propose that the authorities which issued imitation-Kushana, Kushano-Radha and Kushano-Vanga coinage in Radha and Vanga, were no other than the kingdoms of Palimbothra and Gangaridai, respectively. The two kingdoms, were Radha-Suhma with Pataliputra as its capital and the port of Tamralipti under its control; and Vanga with unknown capital and the port of Gange within its domain.

Having established the existence of two independent kingdoms in Radha-Suhma and Vanga, let us now proceed to identify characters of the functional political powers that asserted claim over coercive legal authority extending over two independent kingdoms in Radha-Suhma and Vanga. A large number of terracotta plaques, seals and seal impressions, clay pots and sherds with Kharoshti-Brahmi inscriptions have been discovered in Chandraketugarh, Tamluk, Hadipur (North 24 Parganas). Beracampa (North 24 Parganas) and other places in lower West Bengal. On paleographic grounds, they date from the second half of the 1st century A.D. to the first quarter of the fifth century A.D. One terracotta administrative seal, semi-circular shape with an oval flat top, bears the following inscription; "from [i.e. of] the *Ganarajya*" (Mukherjee 1990: 48).

The term 'Ganarajya' deserves special attention, because it literally denotes 'rule of the assembly'. More precisely, the application of the term indicates that the two states were oligarchies comprised of either a single clan or a confederacy of clans. As in the case of the pre-Mauryan Janapadas, the most important institution of the *ganarajya* of Radha-Suhma and Vanga may have been a sovereign general assembly, or *parishad*, which may have had the authority to election important functionaries. The king of the *ganarajya* (such as Juju mentioned above) may have functioned with the assistance of a council of elders. That the state maintained an army is indicated by a seal-impression from Chandraketugarh (2nd century A.D.) that bears the following inscription; "Moboda, the soldier (and) the offspring of the leader of the Medas" (Mukherjee 1990: 50). It is very likely that the soldier named Moboda cited in the seal was a captain or a general for he appears to be proudly declaring his lineage. It appears that the states of Radha and Vanga devoted considerable energy in international diplomacy for furthering mercantile interest. This is amply testified by *Shui-Ching-Chu* and *Fu-nan-chuan*. It will be recalled that *Shui-Ching-Chu* describes the voyage of an embassy from the king of Tan Mei (Tamralipti) to the court of the southern Wu dynasty (222-280 A.D.) in Nanking. *Fu-nan-chuan* also indicates close political links with the Chinese.

There are clear indications that the states were financed by revenue contributed regularly for their functioning. A seal-impression from Chandraketugarh (2nd century A.D.) attests that the royalty maintained bureaucratic machinery since the impression in question has inscribed on it "Office of receipts and expenditure" (Mukherjee 1990: 50). One may believe that the merchants in Radha and Vanga paid some kind of tax or revenue to obtain permits from the state in order to engage in trade. If one is not stretching one's imagination too far, it may also be safe to believe that the traders were private operators, from whom the state levied revenues. The "office of receipts and expenditure" cited earlier might actually have been the royal treasury that received these revenues. These assertions may be amply substantiated with the help of two terracotta objects discovered at Chandraketugarh (2nd century A.D.) that bears seal-impressions on both sides. The impression on the obverse of one of these (Asutosh Museum, Acc. No. T 4312) is in Brahmi. The legend appears to be decorated with ears of paddy. It reads, in translation, "grains [of the value of] 90 *karshapanas*". The impression on the reverse displays a vessel with stalks of grain, flanked by two auspicious symbols. A marginal legend, in translation, reads; "[issued] by [the] wise [councilors] from Tirajachata". Another inscription incised on the edge reads: "of Devajnatamitra, the wealthy (or old, i.e., senior) carrier [of merchandise]". The impression on the obverse of the other terracotta object (Asutosh Museum, Acc. No. 6) shows a Yupa-like device and an inscription which reads; "grains [of the value of] 90 *karshapanas*". One of the inscriptions on the reverse is not legible but the other can be read; "of Aja, the wealthy (or old, i.e., senior) leader". Mukherjee (1990: 48-49), whose reading is cited above, shows that both the objects under review were sale and/or transport permits, each carrying "a royal seal, a seal of a local authority and the name of a trader".

Devajnatamitra and Aja must have obtained permits from the state by paying levies to transport grain carried in bags, each of which was worth 90 *karshapanas*.

Merchants such as Devajnatamitra and Aja may have possessed their own means of transportation such as bullock-carts or riverine boats. This is indicated by a terracotta object (Asutosh Museum, Acc. No. 1035), which is believed to have been a trader's identification ticket. It displays a boat containing stalks of grain, a conch and taurine symbol. The Kharoshti-Brahmi inscription, which the ticket bears, has been translated as follows: "a vessel containing grain". It is possible to believe that the ticket was attached to a boat sealed with grains meant for merchants such as Devajnatamitra and Aja. Since the ticket was found at Bangarh, it might be suggested the boat carrying consignments of grain was meant to be transported from Bangarh (which may have been a regional exchange centre), where local agents of the merchants would have attached such tickets after loading the boat with grains. The find-spot of the ticket also indicates that Vanga and Radha maintained trade links with Pundravardhana. We may hence believe that local agents in regional exchange centres acted as representatives of affluent merchants who operated from large urban exchange centres.

The traders in Vanga and Radha possibly operated under some form of organised structure. This is indicated by a terracotta object from the 3rd century A.D. that has been discovered at Chandraketugarh. The obverse of the object shows the impression of a matrix with a boar (or a bull) and marginal legends. The legend on top can be read as "grains [of the value of] 90 *karshapanas*" and that of the bottom as, "This is the eternally known [seal] of the persons having the grain [of wealth] as (their) conveyance". Along with a taurine symbol, the name, 'Vamaka' has been stamped twice (Mukherjee 1990: 54-55). The "persons" cited in the seal refer to an organised structure, possibly a guild, which existed during the Mauryan era. It is possible that Vamaka was a trader and a member of the guild. The terracotta object serving as an identification ticket must have been attached to Vamaka's grains loaded in a bag or sack containing 90 *karshapanas*. If this were true, it may also be suggested that Vamaka may have paid some form of tax or membership fee to the guild.

Having arrived at a picture of internal trade and mechanism of taxation, we may now focus our attention on maritime trade. The first evidence that we may examine is a seal impression (c. 2nd century A.D.) that was discovered somewhere in the district of 24 Parganas (South). It shows a boat or a ship with two long masts, with a hanging ladder from one of these. The inscription on the seal has been translated thus: "[The seal of] Dhe(or Dhai)jula, (who is) being in water". The pictorial and written signs have been read to indicate that the person mentioned in the impression, Dhejula or Dhaijula, was somehow connected with maritime trade, either as a seafarer or a manufacturer or an owner or a middleman in the shipping business (Mukherjee 1990: 61). Although the seal impression is vague regarding the occupation of Dhejula or Dhaijula, evidence of three terracotta objects found from Chandraketugarh (Department of Archaeology, West Bengal, Accession No. CKG 184 and CKG 180/T. 687, and Indian Museum, Accession No. 90/181) is more specific. These are trader's identification tickets belonging to the 3rd century A.D.

We have definite evidence regarding the existence of exchange centres during this era from the *Periplus* (Section 63). The oft-quoted passage reads: "On its bank is a market-town which has the same name as the river, Ganges" (Schoff 1995: 47). Tamralipti also could have been an exchange centre if we may take available archaeological evidence into account. We have no further details, but the abundance of copper coins clearly indicates that there must have been many more inland exchange centres. Two of these must have been Pundranagara (Mahasthan, where both Kushana gold and copper coins have been found) and Kotivarsa (Bangarh, where a terracotta piece with Kharoshti-Brahmi inscription discussed above, has been found).

A large quantity of cultural material was discovered from Pundravardhana, Radha, Suhma and Vanga such as Northern Black Polished Ware, Rouletted Ware, stamped ware, footed ware, earthen and high-tin bronze knobbed ware, semiprecious stone beads, glass beads, pearls, etc.. The distribution of these products clearly indicates a flourishing maritime trade with southeast India and southeast Asia. Literary evidence add more commodities in the list. Malabathrum, Gangetic spikenard, muslins of the finest sorts, raw silk and silk yarn and silk cloth from China, (from *Periplus of the Erythraean Sea*), ebony (from Strabo who cites Megasthenes), rhinoceros (from *Chien-*

Han-Shu). Such prosperous commercial and cultural connections would not have been possible without well-organized states.

Attempting to explain the presence of Kharoshti-Brahmi inscriptions in Vanga and Radha where Brahmi script was in use during this era, Mukherjee (1990: 9) hypothesizes that they must have been introduced by the people who used Kharoshti script. The latter (i.e. Kharoshti script) was used mainly in the northwestern region of South Asia, which today constitutes northwestern Pakistan, parts of Kashmir, Punjab, Himachal Pradesh and Haryana in India. The terracotta objects displaying Kharoshti-Brahmi inscriptions leave no doubt, as Mukherjee (1990: 14) argues, that "Kharoshti script was not introduced in the territory of lower West Bengal by the Kharoshti using emigrants from the north-west before the later half of the 1st century A.D." In order to facilitate transactions with the local inhabitants of Vanga and Radha who used Brahmi, the Kharoshti using emigrants began to use the 'Mixed' Kharoshti-Brahmi script, sometime after the late 1st or the 2nd century. We may also find it acceptable that a community or communities of Kharoshti speaking people from the northwest migrated in the early centuries of the Christian era and settled in southern West Bengal. As the distribution pattern of the objects indicates, the settlements of these communities were concentrated in Chandraketugarh (the emporium of Ganga) and Tamluk (Tamralipti).

Although the exact relationship of the Kharoshti-users in Vanga and Radha with the Kushana ruling class is uncertain, it may not be unreasonable to assume the Kharoshti-users of Radha and Vanga, were also the Kushanas. It may be recalled that Kushana provinces were assigned to satraps who "wielded full powers, had the right of succession in their lines and in some cases assumed the title of *rajan* at the same time. ... What tribute they paid is not known, but the title has a tributary implication" (Kosambi 1975: 247). So great was their authority that "it is not always clear who the overlord was for the Indian satraps, e.g. Hagana, Hagamasa, ... Rajula at Mathura" (Kosambi 1975: 247). It may be tentatively proposed that the Kharoshti-users in Vanga and Radha initially arrived as Kushana conquerors and administered Vanga and Radha-Suhma (including Bihar) under two satraps. Later, the satraps began to wield their authorities like, or even more than Hagana, Hagamasa, ... Rajula at Mathura. Juju, the conquering king cited earlier was one of these independent satraps who assumed the title of *rajan* and may have acknowledged token overlordship of the Kushana Empire. This may not be too difficult to conceive given the fact that the Kushana Empire extended right up to the Ganga valley in north India. Hence, the two kingdoms of the migrant Kharoshti-using people in Radha-Suhma and Vanga would actually have bordered the Kushana Empire. This can also explain why the indigenously minted imitation-Kushana, Kushano-Radha and Kushano-Vanga coins have been found to such a large extent in Radha-Suhma and Vanga.

The continued use of Kushana devices in the imitation-Kushana, the Kushano-Radha and the Kushano-Vanga coinage systems implies that Radha and Vanga maintained close political links with the Kushana Empire. Initially, when the imitation-Kushana coins were issued, the link may have amounted to political vassalage. Later, when the Kushano-Radha and the Kushano-Vanga coins were issued, we may assume comparatively greater independence of Radha and Vanga. The significance of the political links with the Kushana Empire needs to be seen in the light of overland trade conducted via the Silk Route. The abundance of Kushana coins in Radha and Vanga indicate that these two kingdoms were connected with the Kabul-Barygaza link via the Ganga-Yamuna river system and the exchange centre at Mathura (which became an important trade centre since the late centuries B.C.; Chakravarti 2001: 68, fn. 152). The link enhanced the importance of Tamralipti and Gangabandar as maritime ports in this era.

If the above-mentioned proposition is acceptable, it is possible to believe that the indigenously minted imitation-Kushana, Kushano-Vanga and Kushano-Radha were issued by Kharoshti-using rulers from the northwest, who belonged to the same tribe as the Kushanas. They ruled, as subordinate allies of the Kushana Empire, not only in western Vanga (north 24 Parganas) as Mukherjee (1990) believes, but as numismatic evidence shows, over the entire Vanga and Radha regions. The Kushano-Radha, Kushano-Vanga and Puri-Kushana coinage systems indicate a complex system of currency existing in Vanga, Radha and Orissa, and a closely related economic system operating with that of the Kushana Empire. A pan-South Asian coinage system like the Mauryan punch-marked coins may not have developed, but the Kushana system was its nearest cousin.

Conclusion

In conclusion, it is clear that prior to the Mauryan era, the authority structure of Radha-Suhma, Vanga and Pundra, was lineage-based. A hierarchical economic organization with a stratified society developed, which may have had given rise to a proto-state formation. Vanga and Radha (Suhma) emerged as clearly articulated kingdom states somewhere in the 5th century B.C. During the Mauryan era Bengal witnessed the earliest state formation, although the notion of the state as conceived by Kautilya does not necessarily imply that this materialized in Mauryan Bengal. Well-organized states acting as instruments for integrating social segments by economic functions, established by the post-Mauryan era, was considerably influenced by the Kushanas' model.

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Tangkhul Naga Megalithic Tradition: A Case Study of North Ukhrul, Manipur*

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Abstract

This paper is an ethnoarchaeological study of the megaliths erected by the Nagas with special reference to the Tangkhul Nagas of Manipur. This is based on fieldwork conducted during the season 2005-2006 in eleven villages of north Ukhrul. These include the villages of Paoyi, Longpi Kajui, Longpi Hirei, Marem, Kharâsom, Chingjui, Lunghar, Shirui, Lângdâng, Hungpung (Hundung), and Hungphun (Ukhrul village proper). The article is divided into three sections. The first section is an introductory note on the Tangkhul Nagas as a tribe within the larger Naga community of India and Myanmar; and on the territory they inhabit in these countries. The second section deals with the typology, geographical distribution and orientation of the megaliths, and the periods to which the megaliths may be assigned. The third section which forms the crux of the present article is a discussion on the changes and continuities in the Tangkhul Naga megalithic traditions through time.

Tangkhul Nagas and their Country

Originally known as *Hao* or *Hau*, the Tangkhul tribe is one of the largest in the Naga community. The Nagas are a conglomerate of more than fifty allied tribes speaking Tibeto-Burman dialects of the Sino-Tibetan linguistic family, and sharing common cultural traits, common legends of origins and migrations, similar political systems and customary laws, and similar, if not identical, modes of production and economic patterns. The current name of the tribe, "Tangkhul", was probably coined by the Manipuris in the early nineteenth century during the famous Seven Year Devastation (A.D. 1819-1826). The Manipuris fled the Manipur valley *en mass* as a result of the Burmese invasion, and took refuge in the neighboring Tangkhul villages. As the Manipuri/Meitei fugitives could not fulfill their basic needs there, they called the place *atângbakhul* (a village of scarcity) from which it is believed that the name, Tangkhul, was derived (Peter 2004: 16). Tangkhul Nagas inhabit a contiguous landmass on the Indo-Burma border. Divided into two parts by the McMahon Line, half of this landmass forms what is today Ukhrul district (northeastern part of Manipur) and southeastern part of Senapati district, Manipur (Fig. 1). The other half forms what is called *Somrah Tract* (in the northwestern fringe of Myanmar). Thus, more than 30 Tangkhul villages are in Burma, while about 230 Tangkhul villages are in India.

Typology of the Megaliths

Judged by their structural and functional aspects we can identify different megalithic types in the Tangkhul Naga country/region. On the basis of their structure, we have following types:

(i) *Menhirs*: they were/are erected singly, or in pair, or in alignment, or in columns forming avenues, or in clusters;

(ii) *Rihai*, a rectangular/quadrangular stone-and-earth platform, generally about 1.8 m long, 1.2 m wide and 0.6 to 1.2 m high (Fig. 2);

(iii) Quadrangular stone-and-earth platform with stone seats round the edge;

(iv) *Tarung*, Y-shaped forked wooden post or multi-branched trunk of a tree; generally about 3 to 6 m tall (Fig. 3);

(v) *Wonrâ*, an oblong/quadrangular stone-and-earth platform, about 3 to 6 m long, 1.2 to 2.4 m wide at the broader end and 0.6 to 0.9 m wide at the narrower end, and about 0.6 to 0.9 m high (Fig. 4, see cover 3). A *wonrâ* may be with or without a menhir, or with both *tarung* and a menhir.

Functionally, there are sepulchral and non-sepulchral megaliths. The former category consists of Menhirs, erected over the graves of the dead and *Wonrâ*, erected over the graves of the dead (Fig. 5). The following types of megaliths are non-sepulchral:

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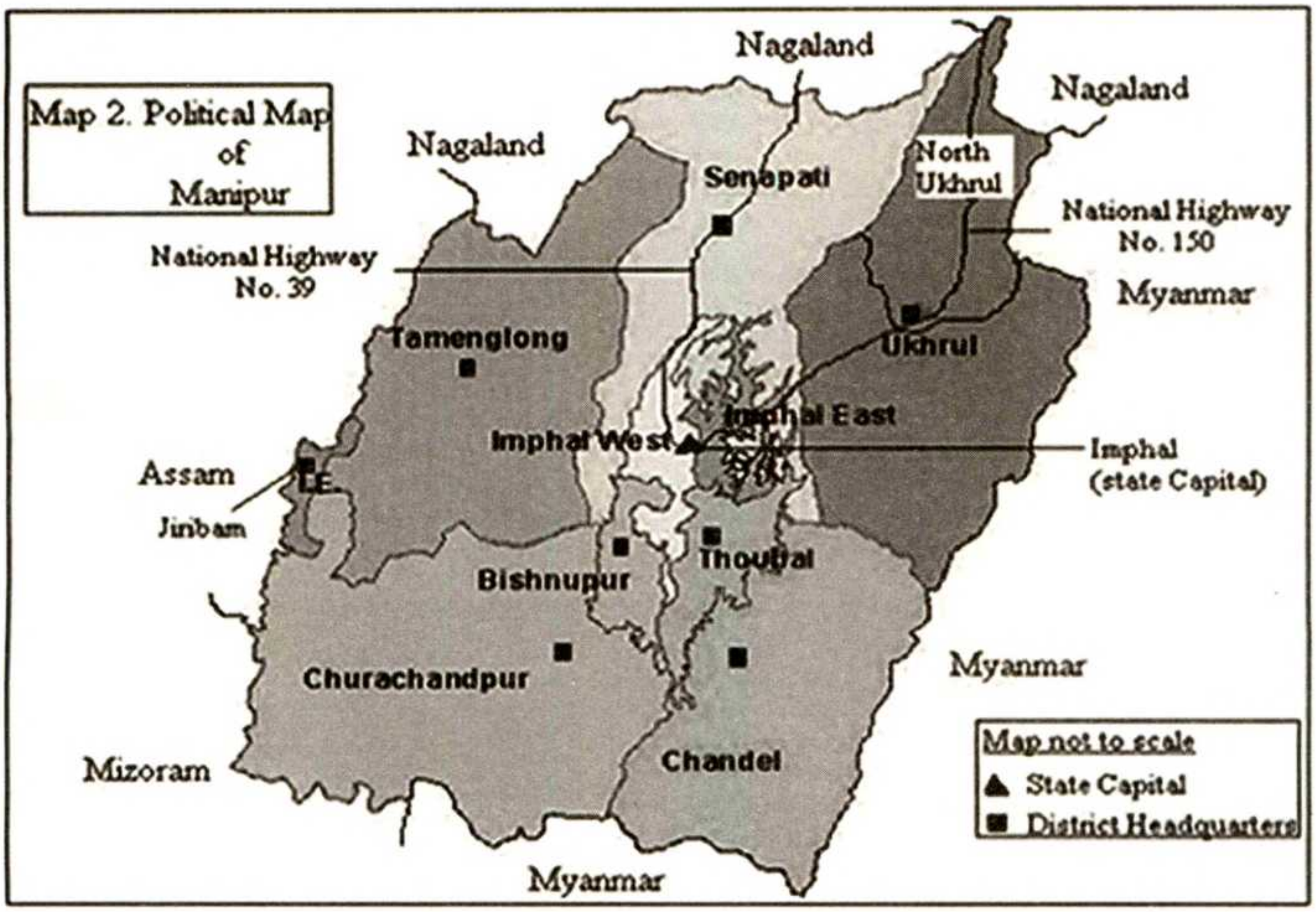

Fig. 1: Map of Manipur showing North Ukhrul (Ukhrul District)

1. *Menhirs*: Four main sub-types are identified, viz. a) *marânlung*, menhirs associated with the so-called *marân* or feast of merit (Fig. 6, see cover 3) *lungchânlung*, menhirs erected in memory of the dead (Fig. 7); c) commemorative menhirs; and d) menhirs erected as witness stones, or as landmarks or boundary stones.
2. *Tarung*: Functionally, there are three sub-types: a) *marântarung*, a *tarung* associated with *marân* (Fig. 3); b) *lungchântarung*, a *tarung* erected in memory of the dead; and c) commemorative *tarung*.
3. 'Sitting-out stone-and-earth platform', meant for recreation and informal discussion on certain issues especially in the evenings after the day's work.
4. *Wonrâ*: two sub-types are a) commemorative, and b) memorial.
5. *Rihai*, or a social-cum-judicial-cum-ritualistic sacred altar.

Chronology

Three temporal phases may be identified based on the nature of the megaliths and on traditions related to migrations, settlements and village formations of the Nagas.

(i) Pre-historic period/megalithic traditions: This includes megaliths datable to the period between the first millennium B.C. to the first century A.D

(ii) Proto-historic period/megalithic tradition: This may date from the first century A.D. to the close of the nineteenth century and the dawn of the twentieth century A.D. This period is also marked by the first writings by outsiders on the Nagas by outsiders.

(iii) Historical period or advanced/living megalithic tradition:. This may be assigned from the close of the nineteenth century and the dawn of the twentieth century to this day, when Nagas themselves started maintaining records about themselves, in the form of records on the deliberations and activities of the church and village court/assembly.

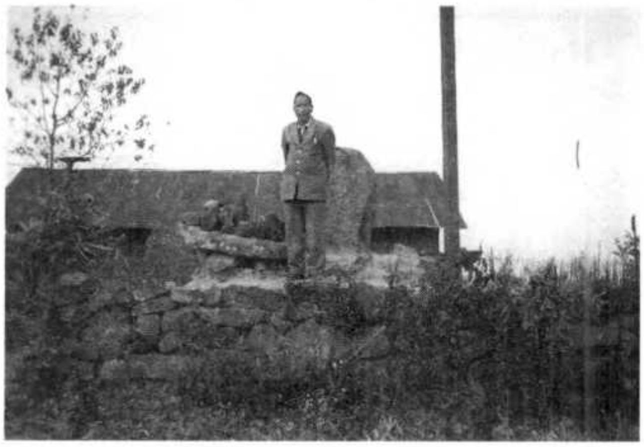

Fig. 2 *A rihai*. Chingjui, Ukhrul (Photographed in January 2006)

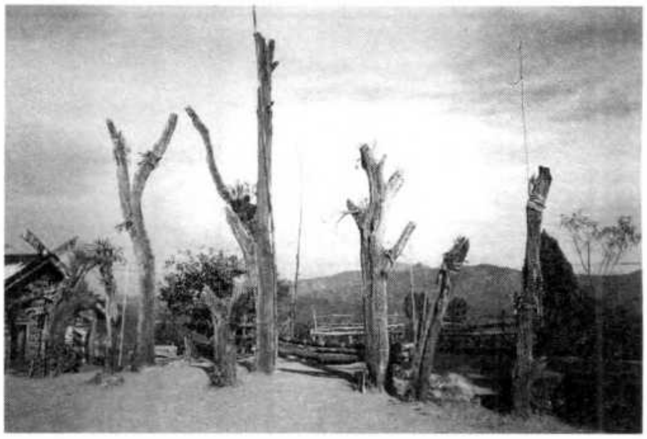

Fig. 3: A group of *marântarung*. Hungpung (Hundung), Ukhrul (Photographed in January 2006)

Geographical Distribution of the Megaliths

A *tarung* was/is always erected within the village settlement area, usually at the courtyard of the owner's house facing the house or perpendicular to it. 'Sitting-out platforms', or *tarong* (wooden translation of the former), were usually constructed at the courtyards of certain influential persons or men of high social status who had performed *marân*. Similarly, the proper place of *rihai* and *rihailung* was the courtyard of the *awunga*, or at the courtyards of the chiefs of various clans. The *marânlung* and *lungchânlung* were/are usually erected either within or outside the settlement area of the village. Within the settlement area, they were/are usually erected in the courtyard of the erector's house. When erected outside the settlement area, they were/are usually erected at certain vantage points by the side of the village paths overlooking the wet-rice fields overlooking the fields. Like *marânlungs*, *wonrâs* were/are also erected outside the settlement area at certain vantage points on the wayside overlooking the wet-rice fields (Figs. 5 and 7).

Orientation of the Megaliths

The orientations of the Tangkhul Naga megalithic structures do not conform to any of the four cardinal points. However, they are subject to a common convention by which they are invariably are oriented towards the village settlement area or the wet-paddy fields. When erected by the side of the village streets or roads they face the streets. Similarly, *tarung* and *marânlung*, when erected in front of the erector's house, are invariably oriented towards the façade of the house or perpendicular to it. In all cases a *wonrâ* was/is constructed or positioned in such a way that it resembles a man sleeping with his face looking up to the sky and facing the settlement (Fig. 4, see cover 3).

Changes and Continuities in the Tangkhul Naga Megalithic Traditions

Morphology

(i) *Menhirs*: Unlike those of earlier phases, most menhirs of the advanced or living megalithic tradition, are inscribed and engraved with various designs-floral, faunal or geometrical figures, and stars. In most cases, they are painted in various colors. However, there are also a good number of them without inscriptions and/or paintings; and, they cannot be accurately dated. Their age can only be ascertained from living oral traditions. In the preliterate and pre-Christian Tangkhul Naga society, the choice of stones or trees for megalithic monuments was determined by their peculiar and commanding appearance and with the consent of the guardian-spirits. Neither the smoothness nor the roughness of the stone was a matter of concern for them as they needed no space for inscriptions. Instead, social memories were recorded by attaching stories or legends to such monuments. In the present Naga literate society, inscribing legends or biographies on such stones has become an important tradition with the aim of perpetuating memories of certain auspicious occasions and/or persons. As such, stone slabs with smooth and plane surfaces are preferred. The need for such stones has grown so much that often machine-polished stones are procured from the market. Moreover, the superstitious beleif of the pre-Christians seeking the 'consent of the spirit' of the stone or tree has given way to a new logical approach.

(ii) *Tarung*: The forked wooden posts or multi-branched trunks of the advanced/living megalithic tradition are usually painted with modern paints. Engravings on them are similar to those of the earlier traditions. The designs include the heads and beaks of birds, heads and horns of

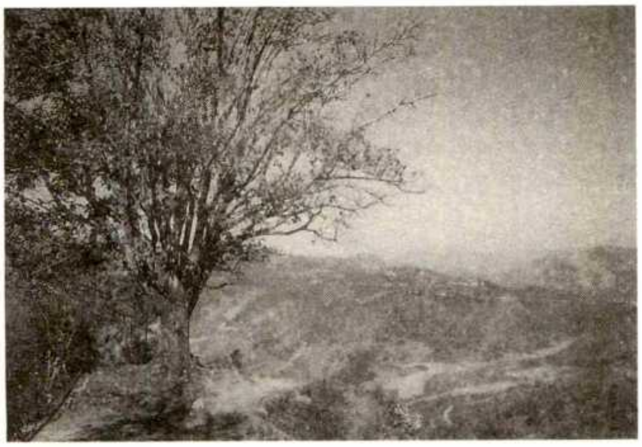

Fig. 5: A *lungchânwonrâ* with a menhir and a banyan tree on it, and wet-rice fields to its north. Lunghar, Ukhrul (Photographed in January 2006)

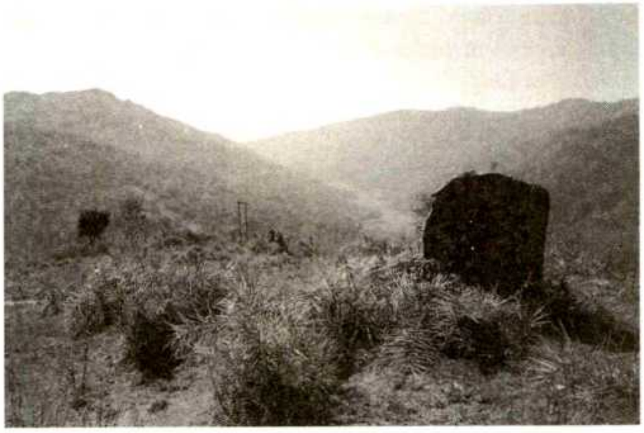

Fig. 7: An alignment of three *lungchânlung*; the middle stone is tilted and invisible in the photograph. To the south of the site are located wet-rice fields. Marem, Ulhrul (Photographed in January 2006)

buffaloes, human heads, stars, circles, and squared grooves, etc.

(iii) *Wonrâ*: No spectacular changes are evident in its basic structure, except that the menhir on it and the *tarung* behind it are often inscribed and painted. A typical *wonrâ* is either rectangular or oblong with one of the ends of its length much smaller measuring only one-fourth of the breadth of the larger end (Fig. 4, see cover 3). The broader end is generally called the 'head' and the narrower end is the 'foot'. Pine trees and other trees likely to afford shade to the passer-by are planted on such monuments (Pettigrew 1909: 41) (Fig. 5).

(iv) *Rihai* (sacred altar): In general, *rihai* is a rectangular/quadrangular stone-and-earth structure. It has become a part of the past as its construction has become unnecessary with the traditional belief systems being destroyed by Christianity.

(v) *Rihailung* (sacred stones): What remains of the preceding (pre-historic and proto-historic) periods remains only as dead elements of bygone days (Fig. 8, see cover 3).

Perceptions

Since time immemorial, stones had been used as landmarks or memorials or as "witness stones" of agreements in various parts of the world. For instance, the *Galeed* or *Jegar Sahadutha*, both invariably meaning "a heap of witness", erected by Jacob and his father-in-law, Laban (Genesis 31: 44-49, *The Holy Bible, NIV*) and the *Ebenezer* ("Stone of Help") erected by Samuel, the prophet, to commemorate God's deliverance of the Israelites from the hands of the Philistines at Mizpah (1 Samuel 7:12, *The Holy Bible, NIV*), were erected as 'witness stones'. The fourth verse of the *Rig Veda* is said to contain an allusion of a rude stone monument as a landmark (Walhouse 1978: 22). The megalithic tombs of north-western Europe (see Kaelas 1981:154) and the megaliths of the Palar Basin in Tamil Nadu (Mohanty and Selvakumar 2002: 328) have also been suggested to be interpreted as "territorial markers". The village of *Mawsmai*, meaning "the stone of the oath", in the Khasi Hills (Meghalaya), is said to have been named so after a stone monument erected in commemoration of a peace treaty between the village and the village of Cherra (Walhouse 1978: 34; Shadap-sen 1981: 29-30). Similarly, the so-called *Linotu* (three stones of dispersion), said to have been "dedicated for the Spirits, Man and Animals" respectively (Nibedon 1978: 18), and the large menhir, called *Tamaratu*, "Stone of Departure" (Shimray 1986: 26), at the Mao Naga village of Makhel (Senapati district, Manipur), believed to have been erected by Naga ancestors during their course of migration and settlement centuries ago, might have been witness stones of their departure and as living testimonies to their fraternal relations.

Walhouse postulated that the use of stones as territorial markers is indicative of the veneration paid to stones in ancient times (Walhouse 1878: 34). Why was this reverence paid to stones? An ethno-archaeological study of the Nagas and their megaliths offers an answer to this mystery. Pre-Christian Tangkhul Nagas looked upon erected stones, or megaliths, as possessing supernatural powers and revered megaliths as eternal/immortal deities. Such ancient practices were imbued with beliefs in some kinds of supernatural beings potent enough to affect the rhythms of nature and human life. In the early decades of the twentieth century, Hodson (1974: 110) noted that "the Tangkhuls took an oath of great weight" upon "a heap of peculiarly shaped stones inside the village". These stones must have been *rihailung*. Hodson also noted that Tangkhul Nagas also swore oaths by deities whom they called "Kajing Karei (or *Kazing Kharei*), Kamyou (or *Kameo*), etc.", and that at Powi (Paoyi), *Kamyou* was associated with a stone in a sacred grove (Hodson 1974: 110-111; words in parenthesis, mine). *Kazing* means sky and *kharei* means great.

So, *Kazing Kharei* means 'the Great Sky God'; and *kameo* connotes evil or malevolent spirit. He also encountered in some other Tangkhul villages stone cairns and heaps of stones, which they held as dwelling places of their deities/gods (Hodson 1974: 188-189).

Some megaliths are believed to be transformed men. In the 1930s, J.P. Mills came across in the Rengma Naga region a small monolith and a legend of "the Mother and Son Stones". The legend recounts that once a man tried to drag the mother stone and the son stone apart, but the mother appeared in a dream and sang to him her story, which is as follows:

> *Singnyu anyu nnyü*
> *Pfü lo nizungcho ungwa*
> *Mi kaho mi niyetsi pyeng kho ti*
> *Tse mi kho mmuyate*
> *Khasa khi sangdrümu thürüchiso*
> *Niyetsi sükebi lo phyinyiho.*
> *(Mills 1937: 230-231).*
>
> *Which means:*
> *I, a stranger, bore a son.*
> *And carried him to this hilltop.*
> *A man tried to tear me from my darling,*
> *But I cannot leave him.*
> *Your deed will bring a storm up from the plains.*
> *Have pity on us and leave me with my darling."*
> *(Mills 1937: 231).*

The mother stone was uprooted and rolled down the cliff in around 1925 by some unknown persons (Mills 1937: 231). The legend around these stones recounts that a man, married a woman from a distant village; he illltreated her and she ran away with her little son. However, both mother and son died at the place where the son's stone lies. They turned to stone and the village folks placed these at the spot where they died (Mills 1937: 231). At Longpi Kajui village, in North Ukhrul, there is a small *menhir*, about 0.9 m tall, standing by the gate of the Holy Spirit Catholic Church. The legend around the *menhir* has it that in the past, whenever the village was raided, the stone assisted its inhabitants. It used to be at a place below the hillock on which the church stands. It was transplanted there only a few decades ago.

These are only a few examples of the thousands of megalithic monuments in the Naga country around which are woven living oral traditions. The significance lies less in the historicity of the legends and tales than it does in the tradition-bearers' perception of the world and nature. It was such a perception that lies beneath the fear psychosis and reverence pre-Christian Nagas had for megaliths. They believed that all things in nature are under the guardianship of some supernatural beings or spirits. This belief in the supernatural qualities of things/nature induced people to qualify them with sacredness, which in turn helped those monuments survive through the ages. Today, with the advent of Christianity, all such perceptions have given way to modern rationality. Nonetheless, the respect megalithic monuments maintained in the past still remains, for by Naga customary laws it is a crime, if not a taboo, to uproot/destroy megaliths erected as memorials or as landmarks.

Functions

To begin with, megalithic monuments in Naga society may be understood as a complex of grandiose manifestations of ideas and ideals. Their socio-political and belief systems and their ideas of perpetuating social memory played pivotal roles in their megalithic practices/traditions. Therefore, different types of megaliths were associated with different aspects of their socio-political and religious activities/practices. For instance, the concept of the soul, or the idea of perpetual existence and immortality of the soul, and the resultant fear psychosis were instrumental in the erection of *wonrâ* among the Tangkhul Nagas. While the megaliths gave such ideas and perceptions monumental forms; in turn these ideas a gave durability to the megaliths.

i) *Wonrâ*

The practical purpose of *wonrâ* was, on the one hand, to serve as the abodes of the souls of the dead, while on the other hand, they were/are cenotaphs, meant for the living to rest as they commute to and from the wet paddy-fields or as they carry home firewood from the jungle (Pettigrew 1909: 41; see also Hutton 1969: 406). In the last decade of the nineteenth century and early decades of the twentieth century, William Pettigrew observed among the Tangkhul Nagas the building ceremony of *wonrâ* and the philosophical ideas underlying the ceremony (Pettigrew 1909: 37-46). He noted that "the last article to be placed on this memorial is a large stone slab, which is considered the most important stone of all, for on it the spirit is said to come and sit during his occasional peregrination around, to view his rice fields..." (Pettigrew 1909: 41). In Shirui village, this flat stone is called *pam*, literally meaning a place or a seat to sit on. In pre-Christian days, this horizontal stone slab was regarded as a seat for the soul of the dead to rest on. The Eastern Rengma Naga *asuthe* (Mills 1937: 220) and the Chakhesang Naga *renni* (Venuh 2002: 247) also served the same purpose. *Renni* is the Chakhesang Naga counterpart of the Tangkhul Naga *wonrâ* and Angami Naga *kwehu*. Beneath the *asuthe/kwehu/renni/wonrâ*, thus, lay the philosophical idea that the dead continued to live with the living within the world;and sharing the same physical horizon of the latter. It was the duty of the living to make abodes for them, lest the wandering souls of the dead harm the living. They were believed to guard the standing crops of their living family members. That was why *wonrâ*s were erected at vantage points with a good view of the paddy-fields. They served/serve as 'meeting points' between the dead and the living. The ancient Chinese also believed that neglected *hun* (the aerial part of the soul of the dead) turned into a sinister force and harmed the living (Wu 1982: 16). Therefore, finding an abode for the *hun* was a matter of necessity, and it was hoped that, once thus sheltered, the spirits would continue watching over the interests of their descendants as zealously as they did in their lifetime (Wu 1982:16). Such a belief or conviction might have induced the living to build megalithic structures for the spirits of the dead. Otherwise, the 'wild' spirits, if enraged by failure to perform necessary rites, could become malevolent causing harm and death to the living. This is best illustrated by the *lungchânlung* and *wonrâ*, erected either over the graves of the dead or at some strategic points, in memory of the dead. Until recently, *wonrâs* were regularly repaired and the grass around them was cleared; once a year during a festival called *Chikhur Mathai Phanit*, i.e. "feast of clearing grasses off the graveyard". On this day *wonrâs* and other memorials to the dead were renovated. It was a day of reunion between the dead and the living at the abodes of the dead. What lay beneath this was the belief in the persistence of a reciprocal relationship between the dead and the living. This idea of settling or placating the souls of the dead seems to have been the crux of the Tangkhul Naga megalithic tradition and practice of erecting memorials to the dead in the form of *wonrâs* and *menhirs*.

This throws light on their belief in the existence of two opposite characters of the soul of man after death: benevolence and malevolence. Just like the *sonum* (the being and/or the state, or simply the 'soul', of the dead) of the Soras of the hills around the Orissa-Andhra borders towards the eastern seaboard of India (Vitebsky 1993: 10) and the *hun* of the ancient Chinese (Wu 1982: 16), the *manglâ* (soul of the dead) of the Tangkhul Nagas becomes an enigma, a powerful but contradictory dialectical causal principle, capable of nourishing its living kin and their growing crops, but at the same time precipitating illness and death among them. For the Soras, an illness in a living being, is a reflection of the attitude of a dead person (Vitebsky 1993: 10). Tangkhul Nagas also had, and still have, the same belief. It is called *Kazei Kazang* (i.e. 'entry of the dead in the living'). Perhaps, the idea of ancestors being looked upon as guardians of the living and their fields/crops and livestock and being held responsible for the fortunes and misfortunes of their living descendants emanated from such beliefs. This is suggestive of the prevalence of ancestor-worship in the pre-Christian Naga society. For instance, on the *Kesi nü shong kedung zong* ("dead men's leaf-cup putting day"), women would place leaf-cups of rice-beer on the graves of their and their husbands' ancestors. These were believed to influence their descendants' crops and general prosperity, and offerings were made in gratitude for the harvests just been gathered (Mills 1937: 173).

ii) *Rihai and Rihailung*

Rihai was/is, in essence, a 'sacred altar' where important rituals were performed; and *rihailung*, secured on this sacred altar, were 'sacred stones', as they were held as the abodes of some omniscient and omnipotent spirits. As such, they were looked upon as 'sacred stones of justice'. In the pre-Christian times (i.e. pre-1900), the *rihai* acted as the court and the church simultaneously. All major disputes were brought for justice before the *rihailung* on the *rihai*. The *sharva̱* (village priest) would then administer the case at the behest of the *awunga* (chief of the village). The disputing parties would step up the *rihai* and take an oath upon the *rihailung*. This was/is called *rihai kakâ* (Kanrei 1970: 79), which means 'stepping up the sacred altar'. As they believed, the one found guilty would die before the end of the year; and that was considered as a right judgment.

In pre-Christian Tangkhul society, *rihai* and *rihailung* were also closely associated with headhunting raids and war. Before embarking on, and after returning from, a victorious raid/war, Tangkhuls performed necessary rituals at the *rihai* to propitiate the *rihailung* or *raihai*. Another name for *rihailung*; is 'magical war-stone'), and the warriors wished to win the favor of the sacred stones (Kanrei 1970: 76). The following morning, the *awunga*, or the *sharva̱*, would observe the *rihailung* for omens. This is called *rihai kakapeo* (Kanrei 1970: 77-79), technically, meaning "observing *rihailung*". If the village was destined to victory, stains of blood or lumps of human hair would be found nesting on the *rihailung* or *raihai* (Kanrei 1970: 78). After a victorious war, the warriors would bring and place the severed heads of the enemies as war trophies on top of the *rihai* and celebrate the victory in revelry (Kanrei 1970: 78). As late as in the early twentieth century, Hodson (1974: 189) encountered in the Tangkhul Naga villages cairns "associated with luck in war". The Tangkhul Naga warriors usually brought and placed his war trophies, i.e. the heads of enemies, on such a pile of stones (Hodson 1974: 117; see also Hutton 1928: 404). This practice was prevalent among other Naga tribes such as Konyak Nagas (Furer-Haimendorf 1976:172; Hutton 1922:243; Hutton 1928:404; Venuh 2003: 170), Angami Nagas (Hutton 1928: 404; 1969: 28), Sema Nagas (Hutton 1968: 174), and Mao Nagas (Hodson 1974: 117; 1985: 6) to name but a few.

In pre-Christian days, men from enemy villages were sometimes captured alive and sacrificed to the deity of the *rihai* and *rihailung* (Kanrei 1970: 75-76). This suggests that in the remote, and even in the recent, past, human sacrifice was prevalent among the Nagas. Both *rihai* and *rihailung*, however, have become a part of the past. Christianity has not only toppled the philosophical edifices of their traditional religion, but also destroyed its material edifices beyond recovery. What remains of the *rihai* and *rihailung* are not only in the most dilapidated conditions but also in terms of their socio-religious significance, they are now simply "dead edifices" of the remembered past.

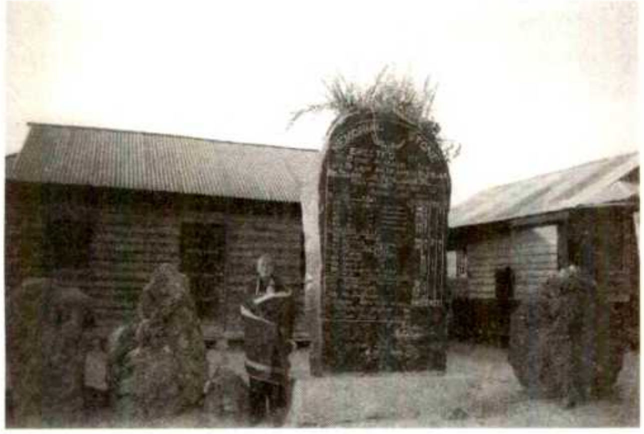

Fig. 9: A row of three old *marânlung* and a new painted and inscribed *marânlung*. Longpi Hirei, Ukhrul (Photographed in January 2006)

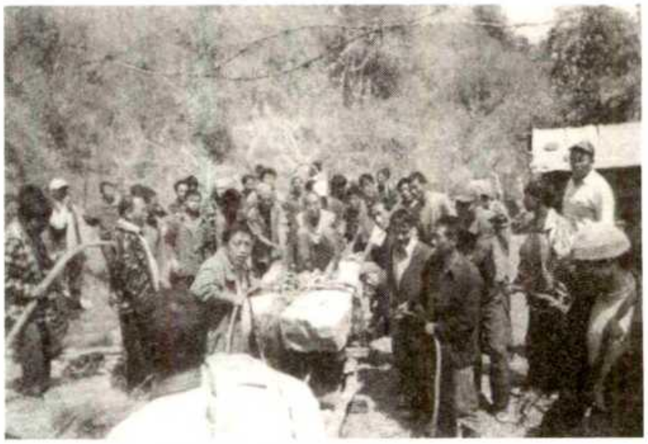

Fig. 10: Stone-pulling ceremony. Longpi Kajui, Ulhrul (Photographed in 2005)

iii) *Menhirs and Tarung*

Tangkhul Nagas looked upon the forests as a natural repository of wealth and riches. As such, they believed that the transportation of *marânlung*, *marântarung* and *lungchânlung* from the forests was tantamount to transporting the fortunes and prosperity of the forests to the house of the erector and thereby to the village at large. This made the erection of megaliths so important for them. Here is a folk song containing an idea of prosperity and fortune, and chanted at the ceremony of transporting *tarung* to its destined abode:

Group 1: "Just as this forest is rich and abundant".
Group 2: "Let his house be rich and have plenty".
Group 1: "As tall and big as this tree".
Group 2: "May our chief be as big and great".
Group 1: "Just as we take this great tree to his house".
Group 2: "May great wealth and happiness come to him..."
(Horam 1977: 29)

Among the Indonesian followers of the megalithic tradition, the horse or buffalo, engraved on their megalithic structures, especially dolmens constructed over the graves of the dead, "symbolize wealth" (Sukendar 2003: 57). The buffalo horns and heads, and the heads and beaks of birds engraved on the *marântarung* and *marânlung*, as well as on the broad wooden posts/planks employed either as pillars as outer screen of the façade of the horned-house of the Tangkhul Nagas, might have performed the same socio-economic function. Very often heads and horns of buffaloes are encountered on the Tangkhul Naga menhirs of the living/historic megalithic tradition (Fig. 9). They connote the slaughter of the animals for the erection of megaliths and the associated feasts. Implicitly, they symbolize the erector's wealth and riches and the associated feasts. By deduction, thus, they symbolize fertility, but not necessarily a fertility cult as postulated by Hutton (1928: 400).

Megalithic Rituals

The Tangkhul *marân* (feast of erecting megaliths) involved various social activities and religious rites and beliefs. As the erection of megaliths entailed the performer to observe a series of rituals and *genna*, or *shâr* in Tangkhul, both meaning "it is prohibited", not all who had wealth could perform it. It was, in principle and practice, meant for the resolute and men of high moral integrity. For months and years at a stretch, the performer and his wife had to remain *genna* and chaste lest inappropriate megalithic rituals might bring bad consequences to the family in particular and the village in general. In Paoyi village, the host couple had to remain chaste for about two years, and the husband would not trim his hair until the completion of the feast. On top of that, a megalithic venture was never complete with one but with a series of five to twelve erection ceremonies spanning many years, sometimes over the entire life of the erector. Moreover, it was equally a common concern of the entire village to make the megalithic venture successful by observing various rites and taboos and extending help in the form of labour to the erector. This opens a new gate for understanding the solidarity of the village community which remains intact to a certain extent in all Naga villages even to this day.

The moment a man conceived of the idea of celebrating *marân*, he would perform various propitiatory rites to avoid displeasing nature and guardian spirits. Paddy divination, egg divination, foul divination, and bamboo splitting divination were also performed to find favorable omens (Shimray 2000: 165; Shimray 1986: 110). Dreams were also invoked to ascertain the consent of the spirits/guardians of the trees, stones, or forests. Ascertained in dreams, each *tarung* or *marânlung* was identified as male or female. As the megaliths were transported to the erector's courtyard, his clansmen would perform a ritualistic dance, called *kameo kashâm mahon* (Shimray 2000:167), i.e. 'shunning the spirits dance', thrusting their spears out through all available holes on the walls of his house to shun the spirits/guardians of the trees or forests from entering the performer's house and harming his family. Thereafter, the megaliths were erected and smeared with the blood of fowls. In the past, the main *tarung*, called *Tarung Akhoka* (i.e. the great *tarung*), was erected by sacrificing a human being and by burying the victim's head beneath the foot of the *tarung* (Shimray 2000: 167-168).

In interviews with the folks of Paoyi and Longpi Hirei villages, similar information regarding *marân*, was given, though not without differences in the minute details. In the former village, the procedure in performing *marân* goes as follows:

a) *Khawok khamasâm* or *maza̱ khayang* or "paddy divination". This is done by soaking a handful of unhusked rice or paddy, and by observing it the next day to discern if the *Âmeoa* (God) favors him to perform the *marân*.

b) If the soaked paddy germinates a cat or dog is accused of disclosing the plan for the feast, it would be killed, and the erector would call in his brethren and would give them a meal. This was the same in Paoyi village also.

c) Then, having announced the plan, the performer's field(s) called *marân râkhong* or *marân lui* (*marân* field), earmarked for the *marân* was worked by the villagers throughout the year's agricultural cycle(Kumrâh 2003:5).

d) A pig would be killed for before drying and husking the paddy for the grand feast day.

e) Another pig would be killed before brewing rice-beer. The process is called *Sâmra̱ Katok*.

f) Another pig would be sacrificed before hewing firewood for the feasting, etc.

g) A bull is slaughtered before quarrying the stone.

h) Four male buffaloes are slaughtered, one for the house with *lengchenggui* (horns on the front gable of the house) and three for pulling the stone(s).

i) Lastly, one pig was killed before erecting the stone. The number of pigs at this stage is determined by the number of stones to be erected.

In Paoyi it was a tradition of the village to slaughter at least two buffaloes and three pigs for each *marânlung* erected in commemoration, for a feast of merit or as a memorial for the deceased family member. The three pigs were respectively for the stone, for husking rice for brewing rice-beer and for the erection (of the stone) ceremony. The buffaloes were slaughtered on the feast day when the entire village was given a grand meal following the erection of the stone. to Three *tarungs* were to be erected at a time, and the processwas believed to be complete with a total number of six *tarungs* (i.e. two groups of three *tarungs* each) or twelve *tarungs* (i.e. four groups of three *tarungs* each). Here, a male buffalo was required for each *tarung*. This stage was marked by the addition of an ox or a bull. For the transportation (of the *tarungs*) ceremony the required number of pigs was four; three for pulling, one for each *tarung*, the fourth one was killed at the erection ceremony. The completion of *marân* in Paoyi was marked by the procurement of meat from a Poumai Naga village in Senapati district, Manipur, known to the people of Paoyi as Malom, at a festival called *Malom Donu*, usually celebrated by the end of April. The couple would then cook and eat the meat in their newly built *lengchengshim* (a house with *lengchenggui*), and they were freed thenceforth from all the associated taboos.

Many of these things, however, have become a part of the past (i.e. pre- nineteenth century and beyond), owing to the influence of Christianity and scientific thinking. However, the pre-Christian belief in the guardianship of spirits over certain landscapes, stones and trees, etc., and beliefs in auguries and dreams have not been altogether done away with. Pre-Christian propitiatory rites made to malevolent spirits of nature have been substituted by prayers to the Christian God. The living Naga megalithic traditions exhibit a very systematic synthesis of the old ways and new ways. The synthesis is done in such a way that the changes imposed on the old ways and the contextualization of the new, or Christian, ways cannot be easily perceived. . The uniqueness of the living Naga (Tangkhul) megalithic tradition, thus, lies in the amalgamation of the old and new ways.

Methods of Transporting Megaliths

Traditionally, a menhir was usually transported by means of a wooden sledge on which rested the stone lashed downwith creepers. The stone was moved by pulling on the creepers attached to the sledge. On the contrary, the *tarung* could not be pulled but was carried by men on their shoulders. Nowadays, with the advent of modern mechanical technology, people prefer to make use this to the maximum. Instead of wooden sledges or wheeled carts, trucks and other vehicles are used for transporting the stones for menhirs or hewn trunks of trees for *tarung*. This does not, however, mean that they have altogether done away with their traditional methods of transporting the megaliths. In most cases, depending on the nature of the landscape where material for the megaliths was obtained; traditional wooden sledges are still utilized to the fullest especially in places where vehicles cannot enter (Fig. 10). In fact, a growing wave of reviving old traditions is sweeping across the Naga society. Very often people prefer pulling the heavy stones on wooden sledges and wheeled carts even on modern roads, and in reviving ancient rituals.

Conclusions

The tradition of erecting megaliths in Naga society was associated with various social and religious activities. The megalithic monuments of the Tangkhul Nagas, to a considerable extent, is reflects theknowledge, ideas and ideals,

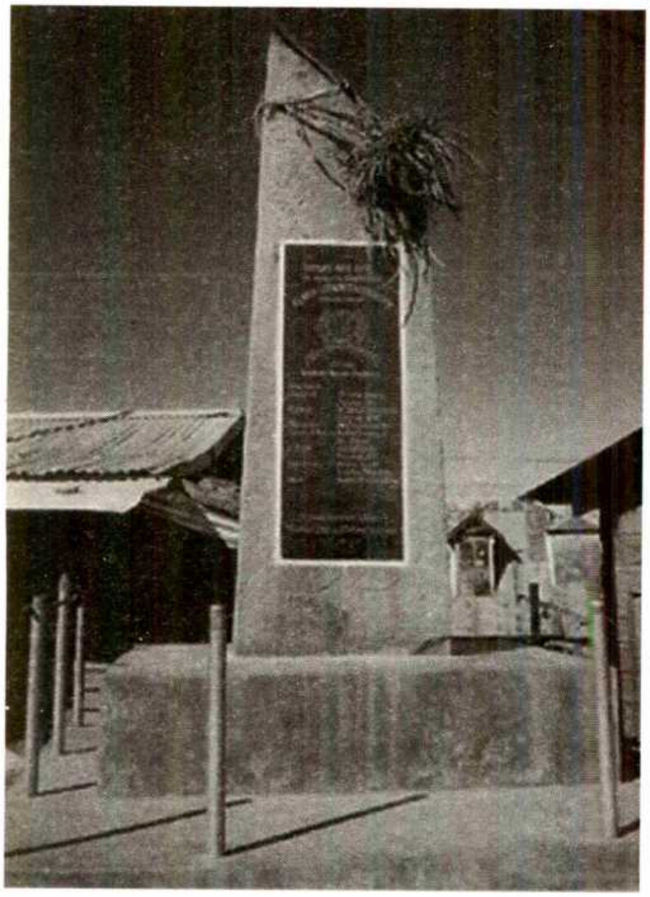

Fig. 11: A Commemorative menhir with an inscribed marble plate. Ukhrul town (Photographed in January 2006)

belief systems and eschatology, customs and traditions, art and technology, and economy of their ancestors of the remote as well as recent past. T.C. Sharma is, therefore, right in saying that "the present practices among the Nagas give us an idea of the beliefs and customs connected with the erection of megaliths in prehistoric times" (Sharma 1991:111-112). G.P. Singh is equally prescient in positing that "the beliefs of the tribal people *concerning* the doctrine of transmigration of soul or life after death and their socio-religious practices, ceremonies and customs constituted the basis and further promoted the growth of Megalithic culture" (Singh 1985:24). Tangkhuls erected and still erect megaliths in memory of their deceased relatives, incurring huge expenses as well as investments in time and manpower. By doing so, the living not only pleased the dead by helping them findresting places on earth and in *Kazeiram* (land of the dead); and also gained respect in society for themselves and their dead. This was usually associated with the so-called *Kathi-kashâm Phanit* ('feast of expulsion of the dead'), celebrated at the end of the year as per the Tangkhul Naga calendar which coincides with the latter part of January. With the advent of Christianity, they have done away with the *Kathi-kashâm Phanit*, but the construction of megalithic monuments, particularly *lungchânwonrâs* continues till this day.

These traditions in Naga society was also closely related to the social status of the individuals or of clans who erected the menhirs and wooden posts ortrunks of trees. In other words, megaliths were used as a means of social and ideological reproductions. The so-called *marân* (the feast of erecting of megaliths) ensured that the performer gained a higher social status; and the erected megaliths perpetuated/ perpetuate his memory after his death. Neither an orphan nor a waif nor an immigrant from another village could perform *marân* or erect megaliths. There are stories and evidence across the Naga country of a few women and orphans who erected megaliths. However, such examples are not only few but also exceptional. Therefore, in Tangkhul Naga society, these practises were strictly status-based and grossly gendered.

One special feature of the megalithic tradition of the Nagas is that it has been a continuous and living tradition. A thorough understanding of the changes in the practices involved in preserving social memories of major events and personalities through time, under the inevitable cultural imperialism of other societies may in a way help explain the vicissitudes of their society in its transition from a pre-literate to a literate stage. Till today, their megalithic structures carry the voices, beliefs, perceptions, thoughts and images of the past. The nature of keeps changing as societies transit from one cultural phase to another The transition of Naga society from the oral to the written stage of transmitting knowledge has caused changes in the perception of memory as well as in the methods of preserving memory. In this trajectory of change, there have also been changes in the morphological aspects and practical meanings of their megaliths. With the introduction of the art of engraving inscriptions the megaliths have now become a material recording memory, and have been transformed from being the embodiment of memory itself, as was the case in preliterate phases. Their traditions show a gradual progression from uninscribed and unpolished megaliths to unpolished megaliths, bearing brief and roughly engraved inscriptions, to well polished, beautifully inscribed and painted megaliths and also megaliths with inscribed marble plates plastered on them (Fig. 11).This trajectory of change from a preliterate to a literate stage and the integration of modern scientific ideas and technology are observed in Naga megalithic traditions.

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Book Reviews

Narmada Valley Culture and Civilization

Editor S.K. Bhatt

2006, (Special Number of the Journal of Academy of Indian Numismatics & Sigillography,
Vol. XXI-XXII, 2006-07), Indore: Academy of Indian Numismatics & Sigillography.
Pages 636, Price Rs. 1000/-(Paperback), US $ 50 (Bound)

The book is a special number of *The Journal of Academy of Indian Numismatics and Sigillography (XXI-XXII*, 2006-07). It deals with many aspects of the Narmada Valley culture and civilization. The archaeology of the Narmada Valley has been studied for a long time and has resulted in many good research publications. The Narmada River is one of the largest rivers that has preserved a long history of human occupation since the Lower Palaeolithic. In the preface, Dr. S.K. Bhatt the Editor, has described the river Namada as a river goddess and praised her repositories of knowledge, culture and civilization.

The book is divided into five sections. Section I is dedicated to proto-numismatics, numismatics and sigillography. Section II deals with archaeology (explorations and excavations). Section III talks about rock art and epigraphy. The last section deals with palaeontological studies.

Section I has 16 papers mainly related to proto-numismatics and numismatics. The first paper by Chandrashekhar Gupta deals with a study of copper tools found from more than half a dozen sites in Madhya Pradesh. It gives the details of the significance and typology of known copper hoards such as those at Gungeria and also highlights new discoveries.

The second paper by Ashok Sachdeva, attempts to look at rock art as one of the sources of proto-numismatics, i.e. the study of economic behaviour of primitive people before the advent, inception and conception of coins. The editor has given an account of hitherto unknown ancient copper coins from Pati, Madhya Pradesh. Rita Sharma and Savita Sharma have given a catalogue of a hoard of silver punch-marked coins from Pati. This is the largest find of silver punch-marked coins containing 3421 coins. A paper by S.B. Ota describes the discovery of a unique wooden seal from Khaparkhera, district Dhar, which was found from an excavation. This is the earliest evidence of its kind in India. Palaeographically he assigns this seal to the 2nd century B.C. Based on a preliminary survey of historical and archaeological sites, Vijayalaxmi Singh has raised some issues and has suggested that historical-archaeological studies should be carried out by using new methods in order to provide a comprehensive and integrated picture of the past. The next paper by Prashant P. Kulkarni deals with new discoveries of coins and their geographical and historical implications. The paper by H.D. Pathak gives details of post-Mauryan history through coins reported by earlier workers. There are a few short communications: -two papers are by C. Gupta, one on a Satavahana punch-marked coin from Ujjain region, and another on a unique un-inscribed die-struck copper coin; an ivory seal of Anand from Vidisha region by S.K. Bhatt; evolution of the bull/ elephant type Yaudheya coins by Devendra Handa; and Vishnukundin type of coins from Nasik, Maharashtra by Sanjay Godbole. The paper by Devendra Handa deals with the origin and significance of the arched Chaitya or the hill symbol. The last paper by Pankaj Ameta gives details of the coins and currency system of the Parmaras of Malwa. However, the paper by Manmohan Kumar (A Judicial Sealing from Hatt, Tehsil Safidon, district Jind, Haryana) is a misfit here because this book is devoted to the Narmada culture and civilization.

Section II has 41 papers dealing mainly with archaeological explorations and excavations in the Narmada Basin. It shows that the Narmada Valley has preserved a rich archaeological heritage. This section gives an account of the varied evidence pf a continuous human habitation since the Lower Palaeolithic. In this section, the first two papers are on human fossil findings from the Narmada Valley. Arun Sonakia presented this paper as an inaugural address of the 'All India Seminar on Contributions of Narmada Valley Culture and Civilization' held in Indore in March 2005. This paper gives details of his famous finding of the Narmada *Homo erectus* skull. A paper by A.R. Sankhyan discusses the hominid clavicle and its relationship with the skull found by Sonakia. There are 15 papers on excavation reports of various Chalcolithic, Early Historic and Medieval sites such as Chichali, Ekalbara, Karondiya, Katanera, Brahamangaon, Khedinia, etc. A few reports on excavations of temples are also presented. Results of recent explorations are reported in some papers. Late Prof. H.D. Sankalia's Navadatoli excavation report, the late Dr. V.S. Wakankar's paper on Chalcolithic cultures of Malwa, and a joint paper by V.S. Wakankar and Prof. V.N. Misra (all reprinted) are key papers, as they are valuable contributions in understanding the culture and civilization of this region.

Section III has eight papers on rock art of the Naramda Valley. It includes two papers on Bhimbetka, one by V.S. Wakankar, and the other on recent discoveries by Giriraj Kumar. A paper by Giriraj Kumar and

R.K. Pancholi discusses Upper Palaeolithic art. S.K. Pandey's paper deals with the pre-historic aspect of Indian rock art. Rock art of Sehore is discussed by D.P. Sharma.

The last section, i.e. Section IV is on Palaeontology. In this section there are five papers. A paper by Verma and others relates to recent discoveries of 140 dinosaurs' eggs from Bagh Lameta. Other papers are on the taphonomy of microvertebrates (by Patnaik) and palaeontological excavations at Narsingpur (by Badam). An attempt has been made by Manuel to understand the co-existence of rhinoceros and man in the Narmada Valley in rock art.

This edited volume covers a wide range of topics relating to the archaeology of the Narmada Valley civilization. Many contributions in the book are based on original field data that appear here for the first time. This is a notable effort as reprints of earlier papers and recent investigations are published in one place. Therefore, it is a must for every library and for all scholars interested in the culture and civilization of the Narmada Valley.

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A Reappraisal on the Prehistoric Rock Art of India

Maliha Nargis Ahmed
2006, Dhaka : Centre for Archaeology & Heritage Research, Bangladesh (CAHR),
Pages 112, Preface, Price Tk. 350; US $ 5.

Wherever rock shelters and caves exist across the globe these possess rock art – painted or engraved or engraved-and-painted. In India, the study of rock art was initiated by A.C.L. Carlleyle in 1867 at Sohagighat area in the southern part of the districts of Mirzapur and Allahabad in Uttar Pradesh. Since then hundreds of rock art sites have been discovered in different parts of the Indian Subcontinent with a greater concentration in the central Indian Vindhyan Region. Reports and studies of Indian rock art have been published from time to time in a number of journals, edited volumes and books.

The book under review is based on the thesis of the author's Masters Degree at the University of Manchester. It mainly attempts to evaluate Indian rock art research carried out by art historians and archaeologists, to compare this with rock art research in Europe, Australia, South Africa and America, and to underline how prehistoric Indian rock art can be interpreted from a different point of view. This book comprises five chapters subdivided under different headings.

Chapter 1 begins with an introduction to Indian rock art. The author has subdivided this art into pictographs and petroglyphs. The number of rock art sites/shelters discovered in India is given as 641 and their regional distribution is shown in Table 1.1. However, sources of this information are not quoted in the text. The reviewer is sure that the number of known rock shelters containing rock art in India is much higher. For example, the numbers of reported rock shelters decorated with rock art are about 650 in Chambal Valley (Madhya Pradesh and Rajasthan), about 240 in districts Mirzapur/ Sonbhadra and about 425 in district Banda (Uttar Pradesh). More and more rock art sites are being reported everyday from other parts of the country.

The location of sites containing pictographs and petroglyphs, and their themes are described in brief in the next three paragraphs (pp. 18-19). It seems that the author is not conversant with the area under study, since Sohagighat and Morihana (Morhana) have been listed in districts of Allahabad and Varanasi.

A brief historical background of Indian rock art research (pp. 19-21) starts with the discovery of rock art sites by Carlleyle (1867) and Cockburn (1898). Contributions of the scholars from India and abroad including F. Fawcett, C.A. Silberrad, C.W. Anderson, Herbert Knox, F.R. Allchin, A. Sundara, K. Paddayya, M. Ghosh, K.P. Jayaswal, D.H. Gordon, V.S. Wakankar, Yashodhar Mathpal, Jagdish Gupta, S.K. Pandey, Shankar Tiwari and Ervin Neumayer. These names are not arranged in chronological order. The names of some other important contributors in this regard, such as R.K. Varma, V.N. Misra, V.D. Misra, Giriraj Kumar (editor of *Purakala*, an annual journal on rock art, being published for about 15 years) may be added to this list.

Under the subheading 'A Scenario of Indian rock art research', the approach to Indian rock art by art historians is reviewed. These scholars considered rock art as representing life styles of prehistoric society. They have discussed the physical condition and state of preservation, problems of proper documentation, classification, subject matter, and chronology. They have related some of these paintings with religious and social rituals and with shamans. The author believes that they have not availed the opportunity to explain inner meaning, and that they have adopted a Eurocentric approach, and focussed mainly on scientific analysis and statistical data to determine the relative dating of these pictures on the basis of associated stone tools and other antiquities. This research consists of nothing but a mere collection of statistical data and information.

Chapter 2 deals with the methodology, documentation and record, subject matter, execution techniques and tools, use of pigments, classification of paintings based on execution style, dating, state of preservation and conservation, and interpretation. The author observes that, the methodology of Indian rock art studies following an empiricist approach is based on four scientific methods: (a) theory free collection of data; (b) classification and analysis of data; (c) induction of explanation; and (d) testing of explanation against further data. It is because researchers believe that "... data speaks for itself. They collect the relevant data based on their scientific knowledge and then classify and analyse the data objectively to fit into their possible pattern to construct a theory, which would be compatible with a pre-designed hypothesis". This is done on certain criterion (style, colour, superimposition, etc.) with the consideration that "... one can draw direct inferences and come up with a general explanation. Finally the explanation has to be tested against further data."

Subject matter, execution techniques and tools, use of pigments, classification of paintings based on the execution style, dating and state of preservation and conservation have been placed under the second step of methodology called "objective classification and analyses of the data' (Rule B). It is observed that "Indian art historians were and are still obsessed with proper documentation and recording of rock art". They consider that it "would eventually lead them to correct interpretation", "that it is impossible to collect theory free relevant data. Data collection on Indian rock art has resulted in the provisions of a visual documentary for us to have a general idea about the paintings and nothing more than that". Indian prehistorians have provided detailed descriptions of animals, human figures, anthropomorphic figures and geometric patterns, their numbers, body postures, execution style, colour quantity and activities. The discrepancies in the identification of the animal species have also been pointed out.

As regards the execution techniques and tools, the extrapolations submitted by Wakankar, Brooks, Mathpal, etc. are quoted. It is pointed out that so far no accurate classification of colours has been done and in every case some general wide and imprecise terms are used. Regarding the use of pigments, much attention is given to their chemical analyses and individual scholars have explained colour schemes used in paintings of a specific region.

The author quotes the criterion applied by Wakankar and Brooks, for dating Indian rock art:- (i) analysing physical conditions of the rock surfaces; (ii) examining successive superimpositions of the paintings to understand style; (iii) finding correlation between the subject matter of the paintings with associated antiquities of already known periods in prehistory; and (iv) known dates within the historic periods. The author finds that Wakankar and Brooks and subsequent researchers were obsessed with establishing a tentative chronological framework for the paintings.

Influenced by Lewis Williams's views, the author believes that "It requires data to be classified before analysis, as data are more susceptible to more than one classification, depending on the discriminating features selected. A classification is designed to elucidate a particular problem. Therefore, the discriminating features chosen to create a certain classification have to be relevant and it is thus a kind of hypothesis. The error of the empiricist approach is that the classification of paintings is inherent in the data rather than in the creation of their own minds, and quite often researchers choose irrelevant discriminating features. Then they attempt to infer explanation from their own pattern not from the artist's creation. This classification also causes a problem in understanding the difference between description and interpretation" (p. 39).

According to the author, interpretation of Indian rock art was given the least attention, which includes a description of the picture considered to be representative of daily life and social and religious activities. These interpretations are based on stylistic features and subject matter, execution style, colour, size, time period and location, etc. Quoting Mathpal, the author has referred to a rule for interpreting the meaning of Indian rock art and underlines that this type of approach may lead to the induction of theory from data for making the general explanation (Rule C). Thereafter, on the basis of Chalmer's observation it is argued that the principles of induction are logically not valid arguments, as one cannot make general assumptions from particular examples. The author has noted that some art historians have rejected the idea of drawing inferences from ethnographic parallels.

After discussing the above aspects of the Indian rock art research, the author arrives at the conclusion that the methodologies adopted in this regard are purely based on empiricism.

Chapter 3 discusses the alternative approach, other than the traditional methods discussed above, claimed to have been successfully applied in the interpretation of South African Bushman rock art, and suggests its application in the Indian rock art research. The author has cited an example, that the quantification of data reflected consistent emphasis on an African antelope as an art object as well as equally consistent avoidance of certain antelope species. This suggested that the artists respond to a widely held cognitive system. Only when theory of quantification could not make a progress, Vinnicombe and Lewis

Williams started to explore ethnographic evidence. This alternative approach showed that the antelope was a polysemic symbol, which was present in many contexts, and researchers realised that rock art was created and produced in a shamanistic context. In this regard, comments of Dowson and Williams are quoted (p. 47): "the art did not illustrate the ethnography, nor did the ethnography explain the art. Each of those arts had to be interpreted and analysed; their metaphors and symbols had to be unpacked and translated to understand the San cognitive system." This theory is further detailed and the success of its application on South African, North American and European rock art is discussed in this chapter. The author observes that this theory is totally free from the Eurocentric approach and hard-core empiricism, and can provide an alternative explanation to some of the rock-paintings and engravings of India.

In Chapter 4, the concept of shamanistic belief in Indian ethnographic parallels is underlined. In this regard, the discussion begins with Pradhan's book (p. 50), which gives the example of two Indian tribal groups who still practice some kind of shamanistic rituals to avoid any kind of natural disasters, etc. The shaman and the man of a particular household go to sleep to have a certain dream during the primary stage of the ritual and after waking up the shaman draws icons dreamt of to please the spirits. The woman of the house also takes part in the ritual. Shamans mainly depict objects found and seen in the surroundings. In the following few paragraphs some examples of rock art of Central, Western, Eastern, Northern and Southern India, supposedly produced in a shamanic context has been discussed. This discussion shows that how some of the compositions described by Mathpal, Neumayer, etc. may be interpreted with the above mentioned approach.

The author has also taken note of Bednarik and Chakravarty's view (p. 57) that "the bio-neurological theory can hardly justify the non-iconic representations of Indian rock art were made in altered state of consciousness. They mentioned examples of trance dancers or medicine men are still found in different tribes all over the world but their aberrant mental state would hardly be the same as their ancestors. Such images can be experienced by human beings independently in different parts of the world in different time culture and environment." However, it is argued by the author that "it is scientifically proven that all human beings share the same central nervous system in respect of time and place. Their cultural and natural environment may differ in due course of time but their psychological experience would never change. Therefore, it is quite logical that by drawing analogy based on relation of relevance from ethnographic evidence an alternative explanation of these paintings and engravings can be offered, which is free from the Eurocentric way of viewing art." The author also claims that the rock art of India can be interpreted from this entirely new and alternative approach.

The conclusions based on the contents of the above mentioned four chapters have been submitted in Chapter 5. This chapter begins with the observation that "unfortunately rock art research of India lagged behind compared to other parts of the world." Further it is observed that in the last two decades considerable numbers of Indian rock art sites were brought to light and properly documented, but its research was and still is caught up with the empiricist view of science and is Eurocentric in approach. Alternative methodology has been adopted in the context of South African, North American and Australian rock art, based on relations of relevance and it can also be applied to Indian rock art studies, as shown by its application on some rock art compositions regarded as hunting scenes. The closing paragraphs of this chapter support this alternative approach.

The appraisal of the book shows that the author has repeatedly emphasised in all chapters that Indian rock art studies are Eurocentric, empiricist and off the mark. The author strongly feels that an alternative approach should be applied to Indian rock art research. In this regard some of the examples are given form the view point of shamanism. However, it is notable here (as the author has also stated) that this approach has been initiated by Pradhan in the context of Indian rock art. Malaiya has tried to find analogies between some dance scenes and ethnographic parallels. Meenakshi Dubey, in context of the rock art of central Madhya Pradesh has discussed some present-day tribal rituals and traditional art with a view of tracing analogies with ancient rock art. Mani, describing the rock art of Laddakh region has traced the inherent meaning of the depiction of ibexes (depicted repeatedly in the region) on the basis of ethnographic and other considerations. The depiction of a giant fighter in a rock painting composition in Sonbhadra, holding an elephant in both hands and trampling elephants under his feet, has been clearly identified with the local hero Lorika. These examples amply show that alternative approaches are not 'entirely new' in Indian rock art researches, although its application on a larger scale, within limitations pointed out by Bednarik and Chakravarti, may certainly be useful. Understanding the meaning and purpose of depiction of various rock art compositions is very complicated and as the author has observed in the closing sentences of the concluding chapter we should remember that – "Perhaps we will never be able to interpret the accurate meaning of the art but it does not necessarily mean that we would not try."

During the last two decades the scope of rock art studies in India has widened with the inclusion of the study of cupules. Bednarik and Giriraj Kumar who have done considerable work on these features, claim that their antiquity dates to the Lower Palaeolithic phase. The outcome of their studies has regularly appeared in different issues of *Purakala* and in other publications. Publications regarding the study of fauna depicted in rock art are also available. Since the author is deeply interested in the study of Indian rock art, a perusal of this literature may be rewarding for her.

Exploration, documentation, chronological studies, etc. are the prerequisites for any study, and are equally important in rock art research. Only after achieving these stages one can arrive at a stage of interpretation and this should not be treated as a Eurocentric approach. Even in the case of South Africa, North America and Australia, these stages of research were completed and then alternative approaches were applied. It should be a matter of satisfaction that these stages have been achieved in Indian rock art studies and new attempts to understand their meaning and purpose have also been initiated. The keen interest and deep insight shown for the reappraisal of Indian Prehistoric rock art and observations regarding an alternative approach, by a young scholar from Bangladesh, are welcome and commendable. The Indian rock art researcher may take inspiration and certain leads from the views expressed in her recently published book.

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Archaeology for Anthropology: Proceedings of the Professor Irawati Karve Birth Centenary Seminar

Editors S.R. Walimbe, P.P. Joglekar and K.K. Basa
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Professor Irawati Karve was one of the leading anthropologists and certainly the most well known woman anthropologist of India during the twentieth century. She spent all her career (1939-1970) at the Deccan College Post-Graduate & Research Institute, Pune, teaching and doing research. Her academic interests were extremely wide and varied, combining biological and social anthropology, origins and functioning of caste, and society as reflected in early Sanskrit literature and contemporary situation. Her research findings, thoughts and theories have influenced the work of a number of anthropologists and continue to inspire others. The Deccan College organized an International seminar in December 2005 to pay tribute to this eminent scholar and assess her work in the context of developments in the discipline during nearly four decades since her death. Seventeen scholars from as many institutions in India and the United States presented papers at the seminar. Besides a number of other scholars from several institutions outside Pune and faculty and students of the Archaeology Department of the Deccan College and Anthropology Department of Pune University participated in the seminar. The papers presented at the seminar were subsequently revised by their authors and have now been published. They are a testimony to the impact of Prof. Karve on Indian anthropology.

Besides the inaugural speech of Dr. V.R. Rao, Director, Anthropological Survey of India and two short biographical sketches of Prof. Karve by A.D. Karve and P.P. Joglekar, the proceedings contain fourteen academic papers which are divided into three sections, namely (1) Prof. Karve's contribution to Indian Anthropology, (2) Cultural anthropology, and (3) Biological Anthropology. Naturally there is a certain amount of repetition and overlap among papers related to the same theme.

We will briefly summarize the individual contributions under each section so that the readers can get a fair idea of the contents of the book.

Section I

In this section three papers are related to Irawati Karve's place in Indian Anthropology.

Nandini Sundar has divided Karve's work into four categories; 1. Physical anthropology and archaeology: anthropometric and blood group investigations and excavation of Stone Age skeletons. 2. Cultural anthropology: kinship, caste, folk songs, epics, oral traditions; 3. socioeconomic surveys: weekly markets, dam displaced, urbanization, pastoralists, spatial organization; 4. Contemporary social comment: women, language, and race

Starting with physical anthropology, Karve slowly moved away to the examination of more contemporary issues. Her main research concern was the biological and cultural variation within India which she valued positively and strongly criticized all attempts to impose uniformity like a common language, common civil code and abolishing caste. While recognizing that caste society prevented nation building, Karve also saw aspects of it like tolerance and awareness of diversity as valuable.

According to Karve (1947:17-18), "the unity of India has always been a cultural unity based on an uninterrupted literary and religious tradition of thousands of years". Karve wanted primary education to be in the regional language and English to be taught compulsorily from secondary school onwards.

Study of kinship patterns was one of Karve's major academic interests. By relating kinship patterns to linguistic zones, she arrived at following variations:

1. Indo-European or Sanskritic organization in the Northern Zone; 2. Dravidian kinship in the southern zone,; 3. A central zone of mixed patterns, found, for example, in Maharashtra; and 4. Mundari kinship systems in the east

Within each zone there are variations between castes and subcastes. The unity in this diversity, according to Karve, was provided by the Shruti literature (Vedas, Brahmanas, Upanishads, and the epics). She compared the North Indian kinship system to Dravidian for its effect on women. In north India a girl goes to live with unknown in-laws after marriage whereas in the south because of the cross-cousin marriage a girl lives among known relatives even after marriage. It is very interesting that even among Brahmins in the south who are originally a part of Indo-Aryan society, and who have certainly migrated to the south from the north, Dravidian kinship practices like cross-cousin marriage and marriage with one's elder sister's daughter are found, practices which will be considered abhorrent by north Indians. The kinship organization of the central zone, shows greater internal variation than the north with some castes allowing cross-cousin marriage in one direction as in the south.

Sundar has pointed out the strong points as well as the flaws in Karve's Kinship book. She sees Karve as a pioneer of feminist writing in sociology because of her sympathetic attitude towards women suffering social injustice both in the past (the cases of Kunti and Draupadi in the Mahabharata) and present.

Karve's work on caste, according to Sundar, is essentially confined to the origin of caste and the unit of analysis. Karve challenges Ghurye' arguments that caste in India is a Brahminical product of Indo-Aryan culture, spread by diffusion to other parts of India and that the smallest endogamous unit or *jati* was a product of fission in a larger group caused by occupational diversifications, migration, etc. Like J.H. Hutton and other theorists of caste, Karve argued that while *varna* system may have been an Aryan import, it was superimposed on a *jati* system which predated the Aryans. In course of time the *varna* and *jati* system were interwoven into an elaborate ranking system. Karve also argued that sub-castes like the Deshastha Rigvedi or Saraswat Brahmins should be treated as caste while the overall category of all Brahmin castes should be designated as a caste cluster. This is because not only did the various Brahman sub-castes not intermarry but they had different marriage rules and were ethnically different from each other. Indeed, there were often ethnic variations even within a sub-caste. The Madhyandin Brahmans, according to Karve, came closer to the Marathas within their region in terms of anthropometric measurements than they did to other Brahman sub-castes. Other caste clusters like Marathas, Kunbis, and Kumhars displayed similar characteristics. For Karve her theory of caste fitted the larger enterprise of how the Indian society came to be what it is.

Karve believed that caste helped in understanding migrations in Indian society. The sub-castes in her view are historical entities, preserving in their exclusiveness the memory of some socio-historical event. The generic terms like Brahmin and Maratha are of no value because they are very heterogeneous groups. The Marathas are a conglomerate of different elements. One must therefore investigate separately the endogamous sub-groups of these bigger divisions in order to get a clear idea of the social and cultural hybridization and the historical process of assimilation which has been going on for centuries. She suggested that the sub-castes (for which she used the word caste) should be genetically investigated to understand their migration patterns. In particular she felt that the study of blood groups might help in understanding migrations.

According to Karve (1963c: 4-5), castes show race mixture to such an extent that at least in Maharashtra if people of different castes, ranging from Brahmans to scheduled castes, are put in military uniform, no anthropologist can pick people belonging to different castes. She also thought that in these facts of similarity of appearance and mongrality lie à hope of breaking the caste society once economic equality of some sort and legal equality are reached

Sundar has also analyzed Karve's studies of inter-caste relations in villages and the role of markets in promoting integration among people from surrounding villages who attend these markets.

Subhadra Mitra Channa has evaluated Karve's contribution in a theoretical framework. Channa lays emphasis on Karve's feminist approach. In her book *Yugant* Karve shows a very sympathetic attitude to the women characters in the Mahabharata. While discussing the status of Hindu women in mid-twentieth century, she finds the male attitude typical of the patriarchal society. She paints a telling contrast between the carefree and happy life of a girl in her father's house and the suppressed life in her in-laws' house where her identity is merged into that of her husband. She critically contrasts the concept of *pativrata* (wife totally devoted to her husband) as understood in the epic *Mahabharata* and as exemplified in the lives of Draupadi, Kunti and Madri with its meaning in the mid-twentieth century society. In ancient times virtue in a woman had a different meaning. Kunti and Draupadi would not be considered virtuous today due to not being virgins and exclusive sexual property of their husbands. But they were exemplary women of virtue in their own times not because of their sexual purity but because they bowed down to every wish of their husbands and the needs of his patriline, suppressing their own desires and feelings to the dictates of patriarchy. This is illustrated by the practice prevailing in some castes of a woman being passed on to her husband's younger brother or other classificatory brothers to produce male heirs for his patriline.

Karve is sympathetic to the women who are queens and princesses but who have no control of their own bodies, and have to act totally according to the dictates of the male elders. According to Channa, Karve carefully documented and substantiated her arguments and set rigid standards of objectivity for herself.

To clarify the position of women, Karve looks at the laws and customs of those times. A son was important in Hindu society for a man to be able to discharge his debt to the ancestors and gods not only by himself making sacrifices and offerings to them but also by ensuring continuity through sons. A woman was therefore important as a mother providing sons for the patriline. If she was unable to conceive from her husband, she could resort to *niyoga* by conceiving from a real or classificatory brother of her husband. This raises the position of the mother in giving identity to her sons, but it degrades the position of the wife in that she is obliged to provide her womb for sowing the seed of her husband's patriline. However, one finds it difficult to agree with Channa when she says that "sexual purity of women, a rigid caste structure and enhanced patriarchy are now considered to be more an influence of westernization than as part of ancient Indian tradition".

Karve's writings refute the commonly held belief that Indian society has been static; instead, they show that it has evolved and transformed over the ages. Karve considered the caste society not a rigid but a loose structure which could take on new units and rearrange old ones. Her reinterpretation of the Mahabharata characters is seen as an expression of her feminist thinking. For example, she sees Gandhari's act of bandaging her eyes not as an act of sacrifice for her blind husband but as an expression of her resentment, anger and revenge for being betrayed. Karve has also questioned the greatness of a number of heroic characters of the epic. For example, she portrays Bhishma, the noble patriarch of the Kuru clan, as very cruel and insensitive to the suffering of the royal women.

S.R. Walimbe has given a compact and excellent review of the development of biological anthropology at the Deccan College since 1939 when Irawati Karve joined it as a faculty member of the combined Sociology-Anthropology Department. Karve's main academic interest was to gain an insight into, and find explanation for the immense biological and cultural diversity characterizing Indian society. She undertook several projects, and carried out fieldwork among a number of castes and tribes and generated a vast body of cultural, somatometric and anthropometric data. After analyzing the data she came to the conclusion that for the biological and cultural study of Hindu society, caste, being an endogamous group, was the proper unit. She suggested the term caste cluster for several castes following the same occupation and having comparable ritual status in society She was of the view that comparisons in respect of biological features should be made between castes or caste clusters rather than between just unrelated geographical or linguistic groups. Karve rejected the prevalent belief among social scientists that sub-castes are formed by the splitting of castes. She believed that so-called sub-caste does not represent a genuine social group and the term should not be used. She carried out an anthropometric survey of the Marathas and her students like K.C. Malhotra and R.K. Gulati and the latter's students carried out bio-cultural studies of several communities in Maharashtra and other parts of India.

Karve collaborated with her archaeologist colleague, H.D. Sankalia, and anthropologist, G.M. Kurulkar in studying the human skeletons recovered from the excavations at the Mesolithic site of Langhnaj in Gujarat in the 1940s, and was of the view that these early people of Gujarat had Mediterranid physical features.

In 1970 Karve passed away suddenly, and in 1973 anthropological studies at the Deccan College came to a stop after the Department of Anthropology was shifted to Poona University campus. However, the Archaeology Department of the Institute was generating enough primary data for anthropological studies. This is because in addition to continuing excavation of Mesolithic sites, now in Rajasthan and Madhya Pradesh, from the 1960s, the Archaeology Department took up excavation of Chalcolithic and Neolithic sites in Maharashtra, Madhya Pradesh, Karnataka and other parts of the country as a major research activity. Sites in Maharashtra and Karnataka yielded human skeletons from burials. These were studied by Dr. K.C. Malhotra of the Deccan College and Prof. K.A.R. Kennedy and Prof. J.R. Lukacs and their students from the Cornell and Oregon universities in U.S.A. However, the amount of skeletal material generated by the excavations was much more than could be handled by these visiting scholars. Hence in 1980 a faculty position of a biological anthropologist was created in the Archaeology Department itself and Dr. S.R. Walimbe was appointed to it. Dr. Walimbe and his students had the benefit of being trained in techniques and theoretical approaches of studies in skeletal biology by the highly experienced American scholars, and therefore their studies are marked by up-to-date and continually improved research methodology.

Early studies, both of living and extinct populations, were mainly concerned with classifying communities into racial categories on the basis of somatoscopic observations on skin and hair colour, hair texture, and other body features and on the basis of anthropometric measurements. Studies of ancient skeletal material were mainly concerned with the shape of the head, face, nose, etc. and stature. The newly emerging approaches, while continuing the somatoscopic and anthropometric studies, shifted their emphasis from racial classifications and biological affinities with other populations to adaptation to environment, diet, pathology, and evolutionary mechanisms. The skeletal material was now studied in relation to the physical environment in which ancient populations lived, their occupation, technology used by them, occupational stress and hazards, and trauma.

The earlier skeletal studies were concerned mainly with racial classification and the study of adult crania received maximum attention while post-cranial bones and skeletons of immature individuals were largely ignored. It is noteworthy that a significant component of the Neolithic-Chalcolithic skeletal material of the Deccan consists of sub-adult individuals. The potential of studying such material for tracing the impact of genetic, nutritional, epidemiological, and environmental factors and metabolic disruptions in the early growth phase of life has been amply demonstrated by the large series from Inamgaon and several other sites in Maharashtra and Karnataka.

For further progress in palaeopathological studies Dr. Walimbe thinks that better coordination between archaeology and anthropology departments and museums having skeletal collections and expertise is required. Walimbe 's lab is studying human skeletal material excavated not only by the Deccan College but also by a number of other institutions in the country.

Section II

The section on cultural anthropology comprises five papers. Three of these - by K.K. Bhan, J.N. Pal and M.L.K. Murty – take stock of the ethnoarchaeological research.

K.K. Bhan reviews recent ethnoarchaeological research in western India on metal, stone bead, and pottery making with a view to developing interpretative models that can be used to test real archaeological situations. He has used archaeological data from Lothal, Bagsara. Nagwada, Nageshwar, and other Harappan sites to demonstrate how ethnoarchaeological studies serve as interface between the archaeological sites and archaeological interpretations.

Since about 1950 archaeologists themselves are collecting ethnographic data to ensure its authenticity. They attempt to systematically define the relationship between behaviour and material culture and ascertain how certain features of observable behaviour may be reflected in the archaeological record.

Bhan first discusses the two approaches – *direct historical* and *general comparative* - that are employed by ethnoarchaeologists and cites several experts on their comparative value. He also laments the indiscriminate manner in which ethnographic analogy has been used in the interpretation of archaeological data. Bhan has illustrated the use of analogy by a few select examples.

J.N. Pal has given a brief account of the cultural sequence of the Ganga valley from the Upper Palaeolithic to the Early Historic period and a summary of the ethnoarchaeological studies carried out there in relation to communities still living at least partially by hunting-gathering, fowling, and fishing, selling of flesh and skins of wild creatures, manufacture of various kinds of craft items like ropes, nets, baskets, cups and plates from tree leaves, honey collecting, entertaining people by snake charming, acrobatics, etc, combining these activities, to some extent, with crime. He has referred to the equipment and techniques used by the hunter-foragers. Some of these communities also practice agriculture and horticulture and keep livestock, mainly goats and poultry. Some researchers have correlated food-gathering practices of these communities with those of the Stone Age hunter-gatherers. In fact, there is a continuity of hunting-foraging tradition from the Upper Palaeolithic to the present. Pal has summarized Shahida Ansari's work on the Mallahs, Musahars and Kols of Allahabad district. Ansari has comprehensively documented the fishing practices among the Mallahs and Musahars and hunting of small game, particularly field rats, among the Musahars.

Pal has also given an account of the traditional pottery making technology in the Ganga valley by referring to the pioneering work of B. Saraswati and N.B. Behura which describes various aspects of pottery making in different parts of India. Among the tribal communities only some Naga groups make pottery and the work is done by women. In the Ganga belt pottery making, especially using the potter's wheel, is taboo to women. According to Vidula Jayaswal, prohibition of pottery manufacture by women is to maintain secrecy of craft skills.

M.L.K. Murty has provided a very fine analysis of the relationship between village goddesses and the economic, social and religious life of the village people and the insight it offers into the early stages of agro-pastoral economy. It is very significant that almost all over India, the priests of the village deities (mostly goddesses) are always men of the lower caste, strongly suggesting that they were the original inhabitants of the village and the deity originally belonged to them. Later on, when Hinduism developed and the caste system came into existence, the people of the upper castes started worshipping the deity to ensure their welfare and protection from her displeasure.

Inter- and intra-caste associations mark, village rituals of the goddess. Fixing the date of the ritual, called *Jatara*, provides an insight into village unity. Village elders fix the day after discussion with villagers. The ritual lasts three days and people from the village as well as neighbouring villages take part in it. A wooden statue of the goddess is made by the village carpenter. A temporary shrine of wooden posts and cross beams covered with dried sorghum stalks is made. Cooked sorghum, grams and millets are placed inside the shrine in a heap. Boiled milk and toddy are brought to the shrine in newly made pots and placed in front of the goddess. Blood offerings in the form of sacrifices of sheep, fowl and a male buffalo are made to the goddess. The rituals are performed by priests of the low castes. These festivals promote integration of different communities and social harmony.

D.K. Bhattacharya examines the possible pattern of combination of numerous evolutionary forces that gave rise to the birth of culture and important trends in social formation. He traces the development of the human skull, jaws, teeth, brain, tool making and cognitive powers after hominoid ancestors came down from the trees and started getting adapted to terrestrial life. According to him, *Homo habilis* and *Homo erectus* were capable of only a power grip. The precision grip which enabled humans to produce lighter and finer tools evolved in the later Acheulian stage. The proportion of non-vegetarian diet slowly increased and language must have emerged around this time to integrate co-operative behaviour in hunting. Bhattacharya elaborates the role of tool making, fire, language, loss of oestrus, and knowledge, in human adaptation and evolution. Delayed maturation in the human child and strong mother-child bonding are explained as provisions by nature for acquiring knowledge and strength necessary for the survival of the species.

Bhattacharya argues that development of initiation rites for young males in many societies probably developed to deter them from entering into reproductive activity, before they were physically and economically strong. Chiefdom developed after the emergence of agriculture as resource distribution and labour had to be controlled. Marriage is believed to have developed at this time as a means of strengthening social ties between two groups. The rise of complex society came after the emergence of metallurgy and full time professionals. Restrictions on the sexual freedom of women seems to have come fairly late, probably in early historic times or even later. Women were able to choose their mates during the time of the Mahabharata and the Ramayana, that is in the first millennium B.C. Men developed different moral codes for themselves.

K.K. Basa has examined the application of anthropological approach, or New or Processual Archaeology to Indian archaeology, with the help of the writings of three scholars who, according to him, have applied social anthropological theories in Indian archaeology. He mentions at the outset, that Indian archaeology combines both British and American traditions by adopting historical and anthropological approaches. New or Processual archaeology developed in the U.S. and U.K. in the 1960s. However, not many Indian archaeologists have taken much interest in New Archaeology.

Basa discusses the use of the diffusionist approach in the writings of H.D. Sankalia and Sir Mortimer Wheeler. He contrasts the Irano-centric diffusionism of H.D.Sankalia with the modified diffusionism of Sir Mortimer Wheeler. Sankalia believed that some cultural traits such as certain pottery vessel forms and incised terracotta beads were introduced in the Chalcolithic cultures of the Malwa region of central India, and adjoining parts of southeast Rajasthan, from West Asia and Turkey, and that Neolithic culture of northeast India was influenced by the introduction of polished stone axes and rice from Southeast Asia. He was of the opinion that nowhere in India there was there undisputed evidence of the local evolution of different cultures and the major cultures of India are chronologically later than those of Africa, West Asia and Europe. Basa questions Sankalia's diffusionist explanation saying that there could not be a monocausal explanation of culture change and that morphological similarity of traits does not provide complete explanation of change

Basa has compared and contrasted approaches to New Archaeology by three of its proponents in India – S.C. Malik, H.D. Sankalia and K. Paddayya. While Sankalia and Paddayya both practiced archaeology as a field discipline and look at New Archaeology from the perspective of practical problems, Malik only talks of theory unrelated to hardcore data. Unlike Binford, Malik accepts the inductive method, limitations of archaeological data and the relative nature of archaeological knowledge. He also argued for adopting a combined historical and anthropological approach. For Sankalia, the New Archaeology was a set of techniques and methods, particularly of the physical and biological sciences and of ethnography to tackle problems in the field. Paddayya has combined a theoretical outlook with intensive fieldwork. He has also reviewed the application of various aspects of processual archaeology in India – ethnoarchaeology, site formation processes, and middle range theory. He has incorporated culture history and processual and interpretative framework, and emphasized the use of indigenous epistemological traditions of studying the past as well as the indigenous notions for the concept of space, causality and explanation.

Section III

There are six papers in this section. Rajan Gaur and R.N. Vashisht have provided an excellent review of palaeoecological and palaeontological research, specially that relating to hominoid fossils, in the Siwaliks during the last two hundred years. The Siwaliks have yielded a variety of Prosimian and other primate genera. Of special interest to palaeoanthropologists are the Hominoid genera which include *Krishnapithecus, Sivasimia, Sivapithecus* and *Gigantopithecus*. The authors have provided comprehensive lists of the mammalian taxa of which fossils have been found in the Siwaliks.

Arun Sonakia has given a brief account of his well-publicized discovery of the hominid fossil at Hathnora on the Narmada. The new information provided by him is that the gravel deposit in which the skull cap was found belongs to the Middle Pleistocene Surajkund Formation of the Narmada Quaternary sequence as worked out by M.P. Tiwari and H.Y. Bhai (1997). According to K.V.S. Rao *et al.* (1997), who have studied the magnetostratigraphy of the Narmada alluvium, the age of the Dhansi formation underlying the gravel deposit is 0.76 myr correlatable to Gauss-Matuyama palaeomagnetic reversal comparable to the Olduvai event. According to Sonakia, the near absolute age of the Narmada man could be slightly younger than 0.76 myr, and the morphological details help to classify the skull to *Homo erectus* taxon with characters more in common with Southeast Asian *Homo erectus* crania of Indonesia. Kennedy, however, prefers to assign the crania to archaic *Homo sapiens.*

A.R. Sankhyan has examined the current status of hominid fossil finds in India. He has briefly summarized the history of geological and palaeontological research in the Narmada valley from W. Theobald (1881) to the present. Theobald distinguished two groups – the Lower and Upper – in the Narmada sedimentary sequence, the Lower Group comprising the basal boulder conglomerate bed and the Upper Group constituting the pale brown sands and loose conglomerate alluvium with the Black Cotton Soil at the top.

In addition to Sonakia's discovery of the hominid calvarium from Hathnora, A.R. Sankhyan and other scholars of the Anthropological Survey of India discovered a right and a clavicle, and a left rib in association with Acheulian artefacts and mammalian fossils. According to Sankhyan (2000) the calvarium is not affined to any European or African hominins, but shows affinities to Petralona, Arago 21-47, Dali, Nangdong and Kabwe specimens among the archaic *Homo sapiens*. On the basis of the 26 mensural traits considered by Sankhyan, the maximum overall affinities of the Narmada calvaria are noted with Petralona in 11 traits, followed in decreasing order by La Ferrassie (10), La Chapelle aux Saint (8) the Kabwe/Dali/Zkd (10), Nagandong (11)/ Sangiran 17 (7), the Ceprano and Steinheim (6), the Arao/ Saccapastor / Amud / Sambrumenchon (5), Shanidarl / Mt Carmel (4), ER3733/ OH9 / Zkd 11, 12 / Swanscombe/ Ehrnsdorf (3), Skhul (2) and Cro-Magnon (1) The Narmada cranium as well as the clavicle show a clear separation from African *H. erectus / ergaster*. According to Sankhyan, the Narmada skullcap is unique, and could be classified as *archaic Homo sapiens* or the *Homo heidelbergensis*. Alternatively, it may be considered as belonging to a different species/ clade that could be assigned a new nomen *Homo narmadensis* which was likely ancestral to *H. sapiens* as well as to the European pre-Neandertahl hominins.

Both the cranial and post-cranial human fossils from Hathnora were found embedded in the basal cemented gravel of the Surajkund Fm. On the basis of fauna, and preserved middle to late Acheulian tools, Sankhyan assigns an age of c 500 kyr to the Hathnora hominin fossils. The lower temporal limit could be taken to be c 236 kyr suggested by the gamma spectrometric U series analysis of a bovid scapula recovered from the hominin site.

According to Sankhyan, the post-cranial elements are useful for reconstructing body dimensions and adaptations of the Narmada hominins. On the basis of the 90 mm length of the clavicle, Sankhyan has estimated the shoulder width of its owner to be 30.6 cm. He thinks that the Narmada hominin was similar to the Andaman Onge females in the width of its thorax. He has calculated the stature of the hominin, on the basis of the length of the clavicle, to be between 115 and 135 cm, a value which shows the Narmada hominin to be shorter than even the modern female pygmy. This size is nearer to the Indonesian Hobbits, *Homo floresiensis* and the east European Damnisi, *Homo georgicus.*

Sankhyan has also calculated Narmada hominin's chest depth and adaptations on the basis of correlation between the conoid index and the second rib curvature. The conoid indices fall in the Pygmy range (76.7 to 83.80) and suggest a modern type moderate chest depth and warm humid tropical adaptation.

According to Sankhyan, comparisons of the Narmada hominin with various middle and late Pleistocene hominins and recent humans in respect of clavicle length, mid circumference and calibre index support the inference drawn from the conoid index, namely that the Narmada hominin is a modern *Homo sapiens*. The mid-shaft index exhibits a general evolutionary trend – the flattened diaphyses in early hominins through the intermediate condition in some of them and the rounded diaphyses in modern humans. The conclusion is reached from the fact that the diaphyses of *Australopithecus afarensis* (68.6 cm) and early African *Homo ergaster* (55.8/61.7) exhibit platycleidy, whereas the diaphyses of the Olduvai *Homo* - OH 48 and the Zhoukoudien *H. erectus* show mesocleidy. The Narmada clavicles (78.6 / 80.0 cm) exhibit further evolution by showing higher mesocleidic condition or touch the eurycleidic condition. The Neanderthal clavicles (68.4 ± 9.1 cm) stand distinct by exhibiting a primitive platycleidic-mesocleidic condition.

On post-cranial evidence the Narmada hominin could be excluded from the Neanderthals or the hominins akin to Neanderthals. If the post-cranial bones belong to the calvaria, they indicate a very unique hominin possessing a large head (ca. 1300 cc) on unusually short/dwarf body, similar to small-brained *Homo georgicus* from Dmanisi in Georgia, and small-brained *Homo floresensis* (the Hobbits) from the Flores Island of Indonesia. Alternatively, the calvaria belong to a Neanderthal/ Pre-Neanderthal European immigrant and the post-cranial bones belong to a different robust pygmoid hominin.

Prof. K.A.R. Kennedy has been actively involved in palaeoanthropological research in South Asia for over four decades. He had examined Langhnaj Mesolithic skeletons in the early 1960s including one specimen from his own excavation in 1963-64. He also had personal interaction with Irawati Karve. In his present contribution Kennedy has given a brief history of the development of biological anthropology, including palaeoanthropology, in India and has highlighted the important research issues which received the attention of anthropologists of Karve's generation.

From about 1960 onwards, in addition to taking anthropometric measurements and identification of races which had dominated biological anthropology till then, consideration of the issues of genetics became important to anthropologists. Irawati Karve grasped the importance of new development in the discipline. Genetic traits were an important element of her research as she and her students surveyed morphological features considered to be under genetic control – dermatoglyphics, skin colour, hair form, eye pigmentation, anthropometrically measurable variables, etc. Distributions and frequencies of observable traits bore implications for the biological relationships of tribal and caste groups to one another.

Around the middle of the twentieth century biologists realized that the so-called subspecies (equivalent of races in biological anthropology) were arbitrary divisions within the natural world. The concept of race became discredited in anthropology around this time. In the same period the study of human biological diversity in genetics and in the morphology of populations adapted to different environments gained importance. In addition to palaeoanthropology, new areas of investigation were human growth and development, nutritional status, birth weights, body forms of trunks and limbs, cranial variables, susceptibility to diseases, and the demographic profiles of mortality, morbidity, fecundity, muscular-skeletal robusticity and health. Palaeodemography seeks to apply these variables to ancient populations for which a skeletal record exists. Forensic anthropologists practice many of the procedures employed in the field of physical anthropology and archaeology.

By the dawn of the present century, genetics appeared to hold the key to unlock many mysteries of the past and reveal degrees of genetic relationships of contemporary populations around the world. However, according to Kennedy, when we seek to find a genetic basis for physical variety, we come across minimal genetic data to explain morphological features, such as stature variables, differences in metabolic rates, frequencies of dizygotic twins and other distinguishing features of modern populations. Therefore, anthropometric and morphological examinations of living bodies as well as skeletons, ancient and modern, remain a critical element in understanding the effects of natural selection, mutation, drift, chromosomal re-assortment and sexual selection in our species, problems not yet resolved by study of the genotype.

According to Kennedy, DNA analyses of ancient bone lead often to disputed results, as in the case of recent attempts to extract DNA from Neanderthal bones in Europe and Late Pleistocene anatomically modern humans from Sri Lanka.

Kennedy has listed the research priorities before South Asian palaeoanthropologists. These are: antiquity of the earliest hominids in South Asia; the biological affinity of the prehistoric skeletons with historic and later populations; effects of prehistoric socio-economic and technological changes on human body form and shape, muscular-skeletal robusticity, sexual dimorphism, ontogenetic growth and development, and dental variables of size and morphology; identification of biological properties which are adaptive to the transition from hunting-gathering to food production; place of South Asian palaeoanthropology in the global context, specially in regard to the Indo-European languages, the concept of the Vedic Aryans, migration of foreign peoples and patterns of gene flow, and diffusion of cultural elements and institutions within the subcontinent and across the borders, position of South Asia vis-à-vis the migration out of Africa or indigenous evolution of anatomically modern humans; and employment of new investigative strategies for the recovery of hominid fossils. According to Kennedy, while genetics will continue to provide data applicable to drawing up diagrams for a clearer understanding of biological relationships among modern human populations, it is not the key to understanding those variables of the human skeleton unrecorded in the genotype, like markers of occupational stress and trauma, rates of growth and development, body forms, artificially created deformations of bones and teeth and other indicators of adaptation to natural and cultural stresses within different geographical environments.

Like Prof. Kennedy, his student, Prof. J.R. Lukacs has also devoted over three decades to the study of human skeletal remains, particularly dentition, of Mesolithic, Neolithic, Chalcolithic, Harappan and Megalithic populations of South Asia. In his present contribution he has evaluated the contribution of Irawati Karve to biological anthropology, particularly her theory of caste origins, and has discussed his own research on issues, specially stature which were of interest to Prof. Karve,

In her research in biological anthropology, Karve examined the interplay between social systems and biological diversity. The effects of caste endogamy on the genetic and physical characteristics of castes and tribal peoples of India were a prime focus of her research. She sought answers questions such as the degree of similarity or distinctiveness of castes and tribes from one another in terms of morphology and genetic structure; nature of differences between castes and between castes and tribal populations in traditional phenotypic components such as stature, skin colour and cranial shape. The co-existence and functional integration of caste groups provided the motivation for Karve's research. She was interested in the processes and mechanisms which were responsible for the origin of castes and of the caste system itself. The general belief among social scientists about the origin of sub-castes was that they originated through the fission of larger castes. Karve wondered if biological variation among castes can tell us about their origin and early history. Her research hypothesis was that is sub-castes displayed a high degree of biological similarity, then fission from a common ancestral group would be a reasonable explanation of caste formation. Alternatively, if sub-castes are biologically dissimilar and display numerous and significant differences in their genetic and anthropometric traits, then they represent heterogeneous amalgamations formed by the fusion of distinctive groups with divergent past cultural and biological histories. In their 1968 article, Irawati Karve and K.C. Malhotra examined the anthropometric and genetic attributes of eight endogamous Brahmin castes of western Maharahstra. Though comprising only 9 % of the Maharashtrian population, the eight endogamous Brahmin castes displayed significantly higher levels of inter-group biological heterogeneity than more numerous groups comprising the Maratha-Kunbi caste. Some Brahmin castes like the Deshastha Rigvedi or Saraswat Brahmins, were found to be more similar in anthropometric and genetic trait frequencies to non-Brahmin castes, such as the Marathas and Prabhus, than they were to one another. This observation that the aggregation of endogamous Brahmin castes with similar socio-economic status exhibited significant biological heterogeneity, and suggested that they attained similar status at different times and through unique historical pathways. A new term 'caste cluster' was coined to reflect biological diversity in anthropometric and genetic attributes among Brahmin endogamous groups. Karve and Malhotra concluded that the fusion model of caste origins played a more critical role in the formation of Brahmin caste cluster of western India than previously believed and had greater general relevance than the fission model.

Karve studied the Mesolithic skeletons from Langhnaj in the mid 1940s. At that time stature was calculated from long bones without reference to other factors. Lukacs' review of research on past and present stature in India shows that trends of increase or decrease in stature reflect adaptive responses to nutrition, occupation, and environment. Bioarchaeological research from Mesolithic sites in northern India reveals tall stature of early foragers and hunters. Estimates of mean stature for inhabitants of Damdama reveal tall males (179.1 cm. ± 8.1 ; n=18) and tall females (173.0 cm. ± 10.1; n =11). These estimates along with those for Sarai Nahar Rai and Mahadaha indicate that early hunters and foragers of the Ganga plain were unusually tall. According to Lukacs (2007: 197), the tall stature may have conferred an adaptive advantage with regard to physiological stress in hot dry climatic conditions and to enhance locomotor efficiency facilitating logistical and transhumant mobility. Lukacs has provided a graphic comparison of stature estimates for Ganga plain male samples with early farmers and nomads of northwest India and with living castes and tribes of India. He chose three groups of sites for comparison on the basis of subsistence pattern, geographic location and chronological context. Group 1 represents early Holocene hunting and foraging people of the Ganga plain. This group is chronologically the earliest and phenotypically the tallest, with an overall average stature of 179.9 cm (± 6.5). Group 2 consists of seven early farming and nomadic skeletal samples from northwest India. It includes Harappan agriculturalists from Harappa (cemeteries R37 and H), Lothal and Mohenjodaro, whose overall stature is 172.2 cm (± 7.5), as well as a series from Timargarha (TMG), Burzahom (BZH), and Chalcolithic Mehrgarh (MR2).

In the last paper in this section S.R. Walimbe has discussed the potential of DNA as a research tool in the biological analysis of Indian society.

DNA studies are helping in understanding man and his environment at the genetic level and unravelling his genetic relationship with other primates, variation and migration in contemporary populations. Changes in population structure, movement patterns during the past, language evolution and the origins of infectious diseases, etc. can be explained using information at the molecular biological level. Nuclear DNA provides information about the individual genetic constitution and kinship in relation to other individuals. Since the mitochondrial DNA exclusively comes from the maternal side, a maternal lineage within a community or a population can be traced using mitochondrial DNA sequences.

On the basis of striking similarities in great apes and man Darwin and other evolutionists of the nineteenth century had concluded that these primates had descended from a common stock. Most members of the scientific community as well as general public were opposed to this thesis. Till the 1960s most palaeoanthropologists defended that split between *Homo sapiens* and African apes occurred as early as 30 million years ago. Close relationship among chimpanzees, gorillas and humans is confirmed from the differences in immunological properties of specific proteins. Further research enabled dating of the chimpanzee-gorilla and human divergence at around five million years ago, and revealed that chimpanzees are more closely related to humans than they are to gorillas. Molecular biology has brought accuracy in the measurement of the degree of genetic difference among apes.

Molecular biological research has shown that mitochondrial DNA (mtDNA) accumulates mutations at a much higher rate than the genes in cell nuclei and therefore could provide adequate calibration for understanding recent population theory and it also offers a powerful tool for inferring population history.

Molecular research can help verify issues relating to population migrations since prehistoric times by tracing the chronology of appearance or disappearance of mutations, and by phylogenetic analyses. Study of the DNA of ancient skeletons and of contemporary populations will help in understanding the origins of biodiversity and trace the human evolutionary and migratory history in India during the prehistoric period.

India has enormous linguistic diversity, with over 325 spoken languages and dialects. These languages belong to four major families, namely Austro-Asiatic, Sino-Tibetan, Dravidian and Indo-European or Indo-Aryan, and are believed to have appeared in that sequence. The areas of Austro-Asiatic, Sino-Tibetan and Indo-European languages are extensive but since Dravidian languages are mainly spoken in India, they are generally believed to have originated indigenously. DNA analyses of the speakers of the four language families can tell us their relative antiquity and thus help us understand the chronology of the peopling of India. Similarly, DNA analyses of dated prehistoric human skeletons from various sites and their comparison with modern Indians can tell us about the relationship of living populations with prehistoric ones. S.R. Walimbe has taken an initiative in establishing a collaborative programme for such studies with the Hyderabad-based Centre for Cellular and Molecular Biology (CCMB).

The proceedings contain very informative and thought provoking articles and are a fitting tribute to late Professor Irawati Karve. The organizers of the seminar and editors of the proceedings deserve congratulations for carefully planning the seminar and bringing out the proceedings within a year.

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Rajasthan: Preshistoric and Early Historic Foundations

V.N. Misra

2007, Delhi: Aryan Books International, Price: Rs.3,500/-

V.N. Misra, one of the illustrious disciples of the late H.D. Sankalia, has devoted his life to working on the ethnography and archaeology of Rajasthan. Misra has done extensive work in Rajasthan right from the Early Stone Age to the Protohistoric period, along with the teams of P.R.L., Ahmedabad and CAZRI, Jodhpur. He collaborated in producing a well- documented sequence of palaeoclimatic and environment changes during the Quaternary period. Misra excavated several important sites - the largest and the most recent one being at Balathal in Udaipur district. I do not think there is any more competent authority today to write on Rajasthan than Misra. We are indeed thankful to him for producing this grand volume of about 450 pages. This book will serve as a reference book and an encyclopaedia for the archaeology, ethnography and palaeoenvironment of Rajasthan.

Misra starts with a detailed chapter giving a geographical background of Rajasthan in which he deals with the geography, physiography, climate, drainage, flora and fauna of Rajasthan. As Misra was a part of palaeoenvironmental projects, he has been able to provide an up to date summary of relevant geographical data. The chapter is illustrated with maps indicating the extent of sand dunes, rainfall pattern, drainage and geological formations.

The second chapter deals with the people of Rajasthan in which he discusses the distribution of population, caste structure, rural economy, language and dialects, religion, tribes and their subsistence economy. The chapter includes some very impressive pictures of tribal people and their activities.

The third chapter gives a brief outline of archaeological research in Rajasthan beginning with Cunningham, Carlleyle, Hackett, Bhandarkar, Tessatori, Aurel Stein, A. Ghosh, K.T. Dalal, Cambridge-Oxford-Baroda Universities' expeditions and of course, the extensive work done by Rajasthan State Department of Archaeology, Deccan College and ASI.

Chapter IV deals exclusively with palaeoenvironment, it gives details of hydraulic changes and the history of palaeochannels. It describes the Quaternary sequence from Jayal, Amarpura and Didwana Formations. In table 4.2 he provides a comprehensive summary of environmental changes in the Thar Desert during the Quaternary period. He also summarises the extensive work by Gurdip Singh and his co-workers.

The next chapter discusses the hunting-gathering stage of the Palaeolithic and Mesolithic periods. Misra describes the Palaeolithic findings in different regions of Rajasthan and geological contexts. The distribution maps and illustrations of artefacts of different periods are of a very high quality. He also summarises details of sites excavated by him viz, Tilwara, Bagor, etc. He supplements the data with detailed a chronology based on different dating methods.

Chapter VI starts with the agricultural revolution as represented by the first farmers belonging to the Ahar Culture. He discusses the distribution of the Ahar Culture sites backed by detailed maps and pictures. He outlines the subsistence economy giving details of plants and animal remains. There is a useful summary of important Ahar Culture sites - Ahar, Gilund, Ojiyana and Balathal. The chapter also discusses social organisation, religion, and artefacts of material culture. The disposal of the dead is adequately covered. Tables 6.1 and 6.2 give radiocarbon dates from Ahar and Balathal.

The emergence of the Harappans in the Saraswati Valley is discussed in detail in Chapter VII. It also gives brief summaries of the archaeological sites of Pakistan. The description of the Kalibangan excavations is detailed. The chapter also discusses the end of the Harappa culture and causes, thereof.

Chapter VIII is devoted to the Ganeshwar-Jodhpura Culture. This was a culture contemporary with the Harappans and yielded a microlithic industry along with an abundance of copper objects and typical pottery. The author does not emphasise the role of the Ganeshwar-Jodhpura Culture in supplying artefacts to the Harappans.

Chapter IX discusses various Copper Hoard sites of Rajasthan. It emphasizes the enigma of the occurrence of the Copper Hoards, far away from habitation sites.

The beginning of the Iron Age is discussed in Chapter X. The Iron Age in Rajasthan is represented by the Black and Red Ware Culture and Painted Grey Ware Culture. The chapter gives a brief summary of the technology, subsistence and ceramics.

Chaptrer XI marks the beginning of the Early Historic Period. It begins with the emergency of the Northern Black Polished Ware (NBP). Good photographs illustrate the finds of the period. It also gives a brief discussion of the technology for producing the NBP gloss. This period is also marked by the appearance of scripts, coins and seals. Towards the end of this period, the Rangmahal Culture appears which in its various traits, continues in the culture of Rajasthan even today.

Chapter XII discusses the occurrence and typology of various megaliths reported from Rajasthan.

Chapter XIII discusses the emergence of Rajputs who ruled Rajasthan for several centuries.

The last Chapter (XIV) gives a summary of the evolution of society and culture in Rajasthan. It discusses the ethnographic, archaeological and cultural evidence. This is a very well written summary of the prehistory and history of Rajasthan. It gives due recognition to the technological attainments of the PGW culture but somehow does not mention the emergence of glass technology with this culture.

Appendix-1 describes the Rock Painting sites of the region; Appendix-2 is a very useful gazetteer of archaeological sites in Rajasthan from the Palaeolithic to the Early Historic period. Appendix -3 lists the Copper Hoard sites and Appendix-4, the Harappan sites. The book ends in an exhaustive bibliography which includes 59 references by Misra alone. A very useful index marks the end of the book.

The author has used lucid and popular language to make the book appealing not only to experts but also to lay readers. Most of the illustrations are of high quality though the plates are not always of the same standard. Some maps like Figure 7.6 are almost illegible. One does not find the mention of the path breaking article by Yashpal *et al.* using for the first time LANDSAT imageries to study palaeochannels of Rajasthan. In such a book one would have liked a more detailed acknowledgement of the contributions made by various institutions, besides the Deccan College, especially in the field of palaeoclimatic research.

It is a landmark publication and a must for all interested in the archaeology, palaeoenvironment and culture of Rajasthan.

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Gurudakshina: Facets of Indian Archaeology

Editor Alok Kumar Kanungo

2007, Part-II. Oxford: John and Erica Hedges Ltd., Pages: 104, Price not given.

This is the second part of the essays presented to Professor V.N. Misra by his disciples. It contains contributions by S.B. Ota, S.C. Nanda, Y. Mathpal, B.S. Harishankar, B. Tripathy and Mala Malla. The essays cover themes from the Stone Age to historical period. Malla's article covers the bronzes of Nepal.

I fondly remember V.N. Misra's dislike for contributing to felicitation volumes. He always thought it was a waste of time, but time mellows us all. It also reflects the devotion and esteem in which he is held by his students. So these two parts, of the same felicitation volume, are dedicated to him. It also shows the range of Misra's academic interests. No wonder, among the living archaeologists, barring perhaps Prof B.B. Lal, Misra towers over others in the fields of archaeology and anthropology.

In such volumes, it is difficult to maintain a uniform quality of papers, so also in this volume. There is no thematic coherence possible either. The only thing that unites this eclectic assortment of papers is the much deserved love and respect of the authors for VN Misra.

The first article is by S.C Nanda and S.B. Ota on Stone Age Cultures of the Indravati Basin (Orissa). S.C. Nanda passed away at a young age, therefore Ota has prepared this article, mainly on the work done by Nanda. It is interesting to notethe following observations made by them on the two collections,

1. There is no significant difference in the proportion of artefacts and the use of varieties of raw material in both collections.
2. The proportion between finished artefacts and simple artefacts remains very similar in both the collections.
3. The density of flake artefacts is much higher in the surface collection than the excavated collection.
4. The microliths in the excavated collection is much higher than in the surface collection.
5. The collection from the excavation is characterized by a lower percentage of flake cores and microblade cores, while the surface collection consists of a high percentage of flake cores and blade cores.
6. Microburins are more common in the excavated collection than in the surface collection.
7. Among the flake tools, side scraper is the dominant type in surface collection, while end scraper is the dominant variety in excavated collection.
8. Knife is absent in the excavated collection, but it occurs in a significant proportion in the surface collection.
9. Triangle and trapeze are more significant in excavated material than in the surface collection.
10. Crescents dominate the microliths in the excavated collection, while the backed blade is the dominant type in the surface collection.
11. Though technology remains same, the typological and morphological variations are distinct in the two collections.

Besides the study of lithic industries in the area, S.C. Nanda also carried out an extensive ethnographic study of the local communities in general and the Gadaba community in particular. The objective of this study was to understand the probable way of life of prehistoric man through ethnographic analogies.

The second article is by Y. Mathpal on Rock Art of Bhimbetka (Madhya Pradesh). He has illustrated ten main styles depicted here. Coloured issustrations of rock art are provided as well, but these are the painted copies of originals. It is always better to have photographic documentation rather than drawings made by the author himself. It is interesting to note some of the anecdotes given by Mathpal which reflect the greatness of the Late Dr. Sankalia in helping the poor students.

The third article by B.S. Harishankar covers the prehistoric to early historic periods of south Kerala. He has given some valuable distribution maps of different types of megaliths found in Kerala and also a comprehensive list of megaliths.

The presence of gold, copper and bronze ornaments, from at least three sites, viz., Puliyur, Arippa and Pulimath suggests external reciprocity, since such raw materials and alloys do not have their marked presence in the region. Beads of agate, feldspar, and carnelian, both etched and plain, have been obtained from a few sites. Carnelian is abundantly reported from the Deccan trap region. Kodumanal, near the Palakkad Gap, linking Coimbatore and Kerala, has been a major manufacturing centre for beads during the Megalithic period. Such beads have been transported from neighbouring regions of Madurai, Thirunelvelly and Coimbatore in later times as well.

South Kerala has a number of internal and external passes in the hills, such as Edagramam, Anchugramam, Aramboli, Ariankavu, Gudallur, Kambam, Thevaram and Bodinaikannur, linking the Vaigai and Kaveri basins in Tamil Nadu. Hence, it was not an isolated region.

Palaeobotanical evidence of rice comes from at least two sites, viz., Arippa in Kollam district and Chokkanad in Idukki district. The tropical vegetation of the region has, however, made it a resourceful terrain for hunting wild animals as well. In fact, Megalithism in south India was based upon agriculture, particularly the tank water irrigated fields with intensive rice plantation, a practice still in vogue. Unlike other megalithic tombs in south India, the absence of animal bones in the megalithic burials of this region also highlights the absence of pastoralism, which, of course, does not mean that there was no domestication of animals and consumption of animal products.

The recovery of fragmented human skeletal remains, burnt and unburnt, from eight megalithic tombs viz., Arppa, Anjunadu, Thondimalai, Mangadu, Sreekaryam, Varalala, Poredam and Chenkalthadam, suggests that people followed the practice of secondary burial as well as post-cremation burial (p. 42).

The fourth article by Balaram Tripathy discusses early historic trade mechanisms in central and western Orissa. His article is illustrated with some good maps as well as by plates.

The last article by Mala Malla on Ancient and Medieval Nepalese Bronzes is comprehensive and valuable both for students of art and iconography as also metallurgy. The article is very well illustrated with several black and white plates.

Alok Kanungo, the editor of the volume, deserves thanks from the archaeological community for editing several volumes under the BAR International Series. The last two papers are a tribute to VN Misra, his beloved *Guru* and a great archaeologist of modern India. This is a book which will interest archaeologists and historians of different periods and regions of South Asia. The volume has been brought out very well.

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Excavations at Gotihawa and Pipri, Kapilbastu District, Nepal

Giovanni Verardi

2007, Rome: IsIAO, Pages 358

The site of Gotihawa (27° 31' 30" N; 83° 01' 05" E) is 4 km southeast of Taulihawa, the administrative centre of the Kapilabastu district of Nepal. The site of Pipri (27° 31' 35"N; 83° 01' 20" E) is at a distance of only a few hundred metres from Gotihawa and 3 km from the famous Tilarukot site. The site of Sisaniya (27° 28' 30" N; 83° 05' 15" E) lies about 8 km to the southeast of Taulihawa, just over 3 km from the boarder with India. All these sites are on the right bank of river Banganaga.

In introducing the area Giovanni Verardi has meticulously listed all previous work of the late 19th and 20th centuries as also archaeological work done at neighbouring sites like Lumbini, Kapilavastu and Tilaurakot. The present excavation carried out by Giovanni Verardi in 1994-2003 revealed Gotihawa to be the place where Kakuchanda lived, and that the earliest occupation belongs to the late Chalcolithic period. This is in conformity with the findings of Purushottam Singh and Rakesh Tewari in the Sarayupar region immediately to the south which indicates that the area was occupied much before 600 B.C.

Amongst the new cultural finds at Gotihawa is the corpus of counters (deliberate pieces of potsherds in different shapes) referable to an illiterate but already complex society. Besides round tokens (pottery discs), halves and quarters of tokens, used for recording relations of production, at the site are numerous counters in the shape of rectangles, squares, pentagons, triangles and round-ended wedges. This has led the author to claim that the inhabitants had knowledge of geometry.

There is no stratigraphic break between the Chalcolithic and the Proto-NBP early Iron Age. The pottery of the period includes better quality black ware and black-slipped ware. It is noteworthy that Gotihawa has given the first evidence of varied baked brick architecture in the Ganga Valley, dating to the 1st half of the 3rd century B.C. and a kiln.

The report is divided into four chapters, appendices, and a Nepali summery.

Chapter I gives information about the study area, geology, geomorphology and flood deposits. Analysis of aerial photographs explains different moisture contents of soils and changes of the courses of river channels. Field survey conducted during 1997-2001 led to the discovery of 116 sites. At 14 of these 1 x 1 m test pits were taken for stratigraphic investigation. The survey has helped in reconstructing the cultural sequence of the whole region from the 1st century B.C to the medieval period and dispersal of artefacts over an area exceeding 5000 m^2. A study at Sisaniya shows it to be a glass making and working site. Glass beads, bangles and glass working waste are mostly of green or aquamarine-blue colour. The presence of blue and white glass paste points to a horizon in the 1st-2nd century A.D. Fragments are very similar to those of Kopia, a NBP-Early Historic site in Sant Kabir Nagar district being excavated by the reviewer. An investigation of probable migration of people and/or technology from Kopia to Sisaniya would be very interesting. Verardi's claim of the finding of a kiln with a totally different structure at Sisaniya is not supported by detailed evidence.

Chapter II gives location of the site Gotihawa as just 9 km north of the Indian border. At present the river Banganga flows 2 km west of the site, but during its occupation it is likely to have flowed nearer to the site. The site was excavated from 1994-95 to 2002-03. For excavation it was divided into 5-125-625 m grids i.e., called central M system. To examine the stratification and its relationship with the stupa and pillar, excavation was carried out without baulks. Five occupation cultural periods were identified.

Material remains of Period I (The earliest settlement dates from c. 12th to 9th/8th B.C) comprised Black-and-Red ware, counters and tokens of square, rectangular, triangular, pentagon and wedge shape, and beads of semiprecious stones. The ceramic evidence is similar to that of the late Chalcolithic phase in the middle Ganga Valley.

Period II ranges from the post-Chalcolithic stage to the regular use of iron. The beginning of the phase is characterized by technically developed Black-slipped ware, leading to proto-NBP ware, a decrease in the quantity of pale-red ware geometric counters, addition of pentagon shapes and disappearance of round-ended wedges. The middle phase sees rise of NBP and appearance of iron artefacts and tools for spinning (spindle-whorls).

Period III, dated between the 3rd century B.C. and the 2nd century A.D., is marked by a Buddhist sanctuary, a stupa, and a 9 ft high Asokan pillar without capital. The stupa seems to have been built in two phases, the first one corresponding to Mauryan structure and restored during the 1st-2nd century A.D. Bricks of different shapes including square, rectangular, triangular and trapezoidal, having traces of plant material, and plastered with kaolin paste, were used.

Period IV, dated to 3rd-6th c.A.D., is marked by the abandonment of the sanctuary and reuse of older bricks. Poor maintenance of the stupa with a covering of kaolin plaster led to the crumbling of the structure. The Asokan pillar was pulled down to the level of footing when the stupa was abandoned. The pillar was destroyed with deliberate action. Presently it is reused as a linga. A significant finding of this period is a group of terracotta animal figurines, mainly horses. Verardi has pointed out the need of an ethno-archaeological study of the figurines to understand their function and meaning.

Period V consists of the post-ancient and modern village. The decay of the Stupa has continued until very recent times, bricks being removed and area being levelled to build huts. The stratigraphy of the deposits in the modern village is characterized by yellow silts of the debris of collapsed huts. Terracotta animal figurines include those of goddess statues, elephant and birds/whistles. Personal ornaments include beads and pendants.

An important aspect of the Gotihawa excavation was to determine the chronology of the Nepalese Tarai with the help of archaeological evidence and eight AMS radiocarbon dates. Most of these dates fall between 650 and 400 B.C. Application of latest internationally accepted calibration curve, available information from site stratigraphy, and TL analysis suggest three phases of occupation: 12-11th, 8th-6th and 6th-5th century B.C.

Study of faunal remains gave evidence of molluscs or Chelonia harvesting and turtle gathering at nearby settlement of Tilaurakot. Archaeobotanical remains were collected from charred daub pieces, brick fragments and phytoliths testify to the cultivation of rice from the end of the 2nd millennium B.C. The archaeobotanical record of rice for Nepal so far was limited to the evidence from the collective burial cave of Mebrak, in the Jhong Valley in western Nepal dated between 4th century B.C. and 1st century A.D. The rice (*Oryza sativa*) from Gotihawa can be considered the first archaeobotanical documentation of its cultivation in the Tarai.

Chapter III describes the excavation at Pipri, located a few hundred metres from Gotihawa and spread over an area of three hectares. It was done on a small- scale to check the sequence observed at Gotihawa, whose deposit was extremely disturbed, and obtain an overall view of the archaeological sequence of the region. But nothing was found to connect Pipri with the Buddhist sanctuary of Gotihawa. This excavation confirmed the chronology of the site proposed by Debala Mitra, namely from the 3rd century B.C. to the 8th century A.D. The stratigraphic sequence points to a continuity of occupation until about the medieval period. Absence of NBP, use of black ware mainly as tableware, and of red ware for cooking and storage are some of the highlight.

The stratigraphy was divided into seven phases: Phase I (2nd century B.C.), Phase II (1st century B.C.), Phase III (c. 0-150 A.D.), Phase IV (2nd to 4th century A.D.), Phase V (early 4th century to 6th century A.D.), abd Phase VI (7th-9th/10th century A.D.).

Chapter IV describes the pottery. The vessels were divided according to ceramic class, after which the sherds were separated into rims, bases and walls. Class determination was performed on the basis of macroscopic examination, which included the colour of the paste, the fabric; the presence, frequency and dimensions of organic and inorganic incursions in the paste; textile assessment of the surface in the form of impressions; the paintings and the thickness of the walls.

The ceramic production of early Gotihawa is similar to that of the sites of the Sarayupar region than of more distant sites of the Ganga valley. There are many similarities in ceramic between Pipri and Kopia. As an example the red ware with triangular, incised decoration and lotus flower decoration matches identically with Kopia. The graffiti decorated pottery at Pipri could be of foreign origin. All pottery types are well illustrated but without scale. Hindi terminology of pottery shapes is useful

Analysis carried out on some NBP sherds has confirmed that the typical lustre and characteristic black colour are the result of enriching the paste with potassium, probably obtained with the addition of ashes of vegetal origin.

Appendix contains republished late 19th and early 20th century archaeological publications on Gotihawa and Pipri. A Nepali summery of the whole work at the end is a welcome addition.

Geomorphological and micromorphological analyses were carried out for all the periods. Terracotta figurine finds comparable well with those of the Ganga Valley civilization. All the finds are drawn with great perspective. Other finds like bangles and beads are well documented. Matrix analysis of each material is the highlight of the report. The text is supplemented with useful maps, drawings and photographs. This is a complete excavation report with much comparative study and analysis of material found during survey, test pits, and in excavations in the middle Ganga Plain. However, the description of structure should have been more elaborate.

An important addition to our knowledge of early India are the geometrical counters, which perhaps in other sites are discarded as potsherds. Only recently has it been realized that the large, varied corpus of Mesopotamia 'tokens' forms an actual system by means of which goods were recorded before the introduction of writing. The report is a model and a must for all libraries and researchers dealing with the Ganga Plain.

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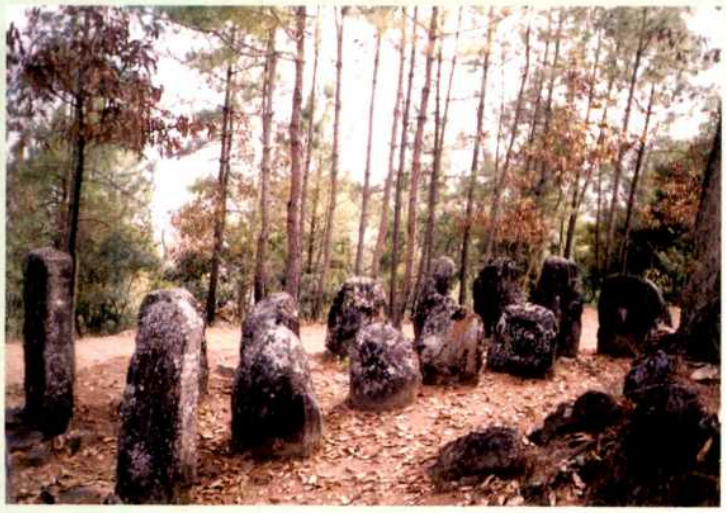

Fig. 4: A *wonrâ*. Shirui, Ukhrul (Photographed in January 2006)

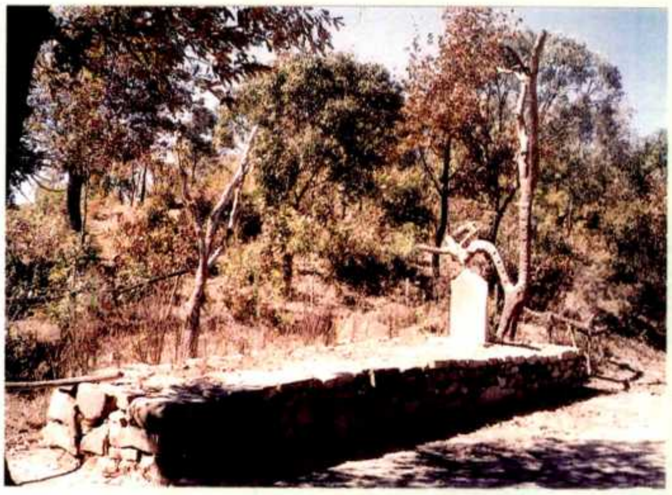

Fig. 6: A group of *marânlung*. Kharâsom, Ukhrul (Photographed in January 2006)

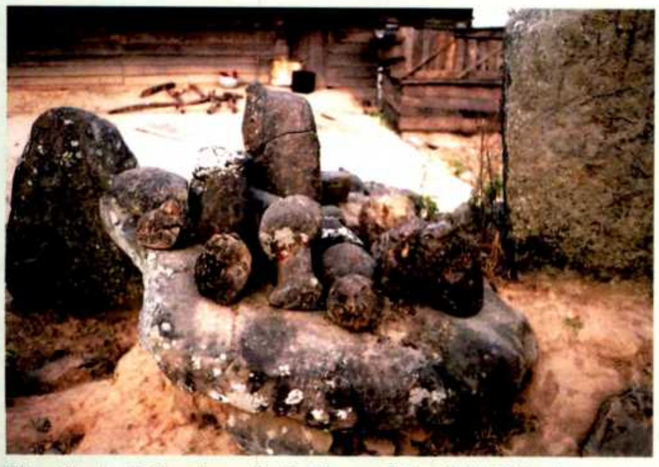

Fig. 8: A Collection of *rihailung*. Chingjui, Ukhrul (Photographed in January 2006)

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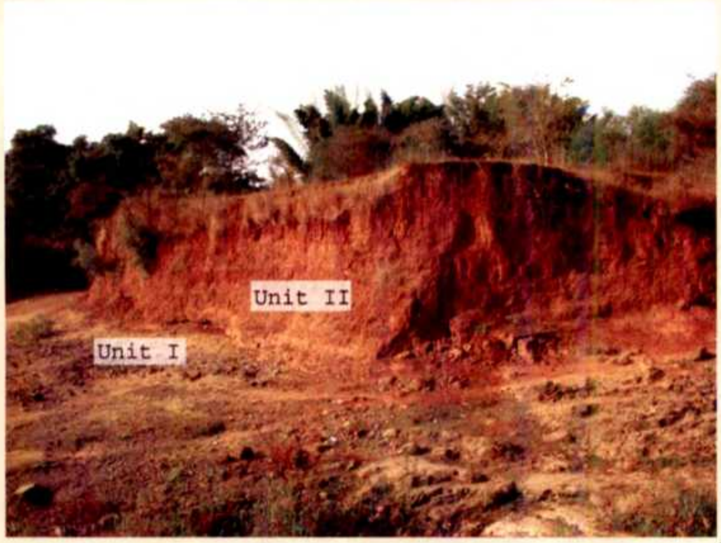

Fig. 3: A section showing basal cobbly gravel rich in laterite and overlying silty unit (Unit I and II) left bank of river Krishna at Pachwad

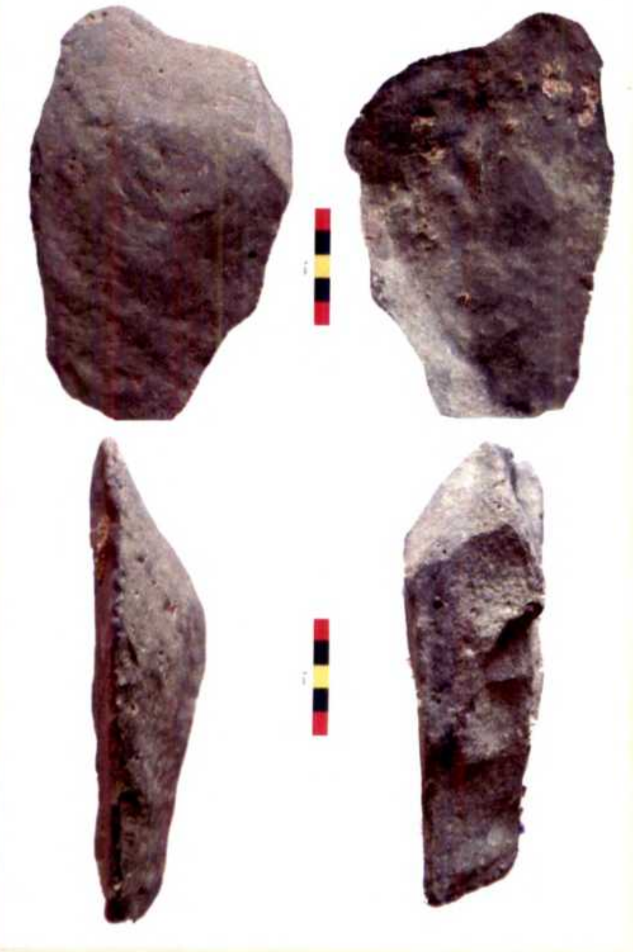

Fig. 4: Large Acheulian Flakes

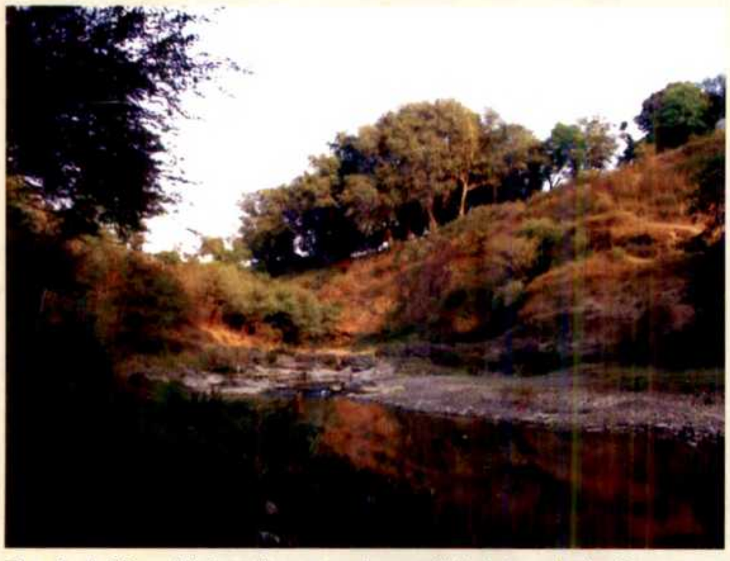

Fig. 5: A 20 m thick sediment and a small knick point in the source region, Kiwara Odha

Charuta J. Kulkarni, Sushama G. Deo and S.N. Rajaguru, *Man and Environment* XXXIII (2): 32-36 [2008].
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Man and Environment
Journal of the Indian Society for Prehistoric and Quaternary Studies

Editor: V.N. Misra
Joint Editors: P.P. Joglekar
Shanti Pappu

Editorial

This issue of the journal, has articles on topics spanning different cultural phases, but with a focus on prehistory and Quaternary geomorphology. Claire Gaillard and others present a study of the technology of the Acheulian assemblage from Atbarapur, Punjab. Kumar Akhilesh's reanalysis of the Upper Palaeolithic 'Damin Industries' of the Bansloi River Basin, Jharkhand provides a detailed study of these industries, discusses their stratigraphic context and examines them in the broader regional perspective. Field studies of the Quaternary Sediments around Wai, District Satara in Maharashtra by Charuta Kulkarni and others indicates that many geomorphological features of the landscape are misfit in the present geomorphic setting, and are the result of Quaternary tectonics and climatic change. They suggest that the colluvial-alluvial deposits in the Krishna Valley probably belong to the Middle Pleistocene. Bishnupriya Basak in her article presents results of her investigations undertaken in the field season 2006-07 on microlithic assemblages of the Ayodhya hill region, Purulia district, West Bengal. The multi-cultural site of Tokwa, Mirzapur District, Uttar Pradesh was excavated by the University of Allahabad a few years ago. P.P. Joglekar and his colleagues from Allahabad provide results of analysis of faunal remains recovered from the Neolithic-Chalcolithic Phases at this site. K. Rajan and his colleagues have contributed an article on the Excavations at Thandikudi, Tamil Nadu that is an outcome of their work done in 2006.

R.N. Singh of BHU and his colleagues have presented an account of their reconnaissance in Western Uttar Pradesh and Haryana. Jaya Menon and others provide results of their work and discuss a tentative chronology for the early history of the site. A.S. Gaur and Bharat Kumar Bhatt in their communication provide an analysis of stone anchors discovered on the Western Coast of the Gulf of Khambhat in course of marine archaeological explorations.

Readers may recall that we have earlier voiced our concern regarding the decline in research in Indian prehistory and the paucity of articles being published on the same. We are happy to state that this issue proves us wrong. We invite young research scholars to contribute articles on this and other subjects in the coming issues.

The publication of this Journal has been financially supported by the Indian Council of Historical Research (ICHR) and the Archaeological Survey of India (ASI). The responsibility for the facts stated, opinions expressed, or conclusions reached is entirely that of the contributors of the articles. The ICHR, ASI and the Indian Society for Prehistoric and Quaternary Studies accept no responsibility for them.

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Cover: Handaxes from Atbarapur

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Technological Analysis of the Acheulian Assemblage from Atbarapur in the Siwalik Range (Hoshiarpur District, Punjab)

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Abstract

The largest collection of Acheulian artefacts in the Siwalik region of the Indian subcontinent is from the site of Atbarapur in the Hosiarpur district of Punjab. It is not dated but recent synthesis of the palaeomagnetic and palaeontolgical data from the Siwaliks shows that some Upper Siwalik sediments are younger than the Olduvai event, but are in any case older than 0.6 kyr. The artefacts from Atbarpur are probably derived from such sediments, thus providing a minimum age for this industry. In spite of its derived nature the assemblage is homogenous and its technological study leads to a better understanding of the character of the Acheulian in this region. Two "*chaînes opératoires*" have been identified, both are similar: short and simple. One was oriented to the production of small flakes, and the second to the production of large flakes. The handaxes and cleavers, typical of the Acheulian, were mostly made on the large flakes often struck from larger flakes (Kombewa method) or from split boulders.

Introduction

In the north-western region of the Indian subcontinent two Palaeolithic industries were identified in the 1930's: the Soanian, named after the Soan River draining the Potwar Plateau (Pakistan) and the Acheulian (de Terra and Paterson 1939, Teilhard de Chardin 1935, 1936, Teilhard de Chardin and de Terra 1936). Soanian assemblages (mainly composed of cobble tools, and flakes) are the most common and occur in numerous sites located on the river terraces or on the divides and plateaus in between, as well as in the intermontane valleys ("duns") formed by the uplift of Siwaliks. The Acheulian is much less common than the Soanian and is usually represented by small numbers of cleavers or handaxes, often only single pieces, from any one locality (de Terra and Paterson 1939, Mohapatra 1981, Mohapatra and Singh 1979, Rendell and Dennell 1985, Chauhan 2003).

Movius (1944, 1948), considered the presence of Acheulian artefacts insignificant in the Siwaliks, and emphasised the Soanian cobble tools in his theory of two cultural zones during the Lower Palaeolithic in the Old World, leading to the concept of a "Movius line". This concept is still being debated (Keates 2002, Corvinus 2004), although in Eastern Asia there are now strong arguments against it with the presence of handaxes or cleavers in south China (Huang 1989, Hou *et al.* 2000), in Korea (Norton *et al.* 2006) in Sumatra (Forestier *et al.* 2005) and in Java (von Koeningswald 1936, Lumley *et al* 1993, Sémah *et al.* 2003). In the Siwaliks also, the large number of Acheulian finds, and the strong suggestion that the Acheulian sites pre-date the Soanian, throws the concept of separate Lower Palaeolithic traditions into doubt. The Movius line however, was more or less accepted in India until the end of the1970's, given the only evidence of Soanian sites (Lal 1956, Mohapatra 1966, Pruffer 1956, Sen 1955). But since 1975 Acheulian artefacts from several localities in the Indian Siwalik Range have been discovered (Mohapatra 1975, 1981 Mohapatra & Singh 1979a, 1979b).

Mohapatra always rejected the idea that the Acheulian implements were originating from the underlying Upper Siwalik sediments as he considered them to be much older than the possible age for the Acheulian. However since the 1980's, not only has the dating of the Acheulian become older (1.2 Myr at Isampur in peninsular India; Blackwell *et al.* 2001; Paddayya *et al.* 2002; Lower Pleistocene at several sites; Sangode *et al.* 2007), but also some formations of the Upper Siwalik sub-group have been shown to be younger than others (Opdyke *et al.* 1979). Recently, Nanda (2002) has reviewed the fauna of the Upper Siwaliks, called Pinjore in India, and has identified two localities – Paramal-Uttarbeni near Jammu and Patiali Rao, near Chandigarh, where fossil yielding Siwalik

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sediments younger than the Olduvai event occur. He dates the end of sedimentation at these two localities at around 0.6 myr. The occurrence of "Acheulian" artefacts in sediments between 1 million and half a million years old is quite possible.

A better knowledge of the assemblages considered Acheulian in the Siwaliks is of first importance. In the entire Siwalik range, from the Indus to the Brahmaputra, Atbarapur (also spelled Atvarpur or Aitbarapur) is the only site known so far, where more than 50 typical Acheulian artefacts have been found, along with flakes, cobble tools and cores. Although not accurately dated, this site provides interesting technical data for further comparisons between western, eastern and southern Asia.

The assemblage studied in this paper was collected in the 1980's by the two Indian authors during their field work in the Hoshiarpur Siwalik Range (Fig. 1). Several publications have described the lithic artefacts and their setting (Mohapatra 1981, Kumar and Rishi 1986, Rishi 1989). This study aims at providing more details on their technology in order to characterise the Acheulian technical tradition in the Siwaliks.

Geographical, Geological and Chronological Contexts

Atbarapur is located about 25 km north of Hoshiarpur, which is the chief town of the district. The north-eastern sector of this region is occupied by the Siwaliks, which represent both geological formations and geomorphological features. The Siwalik sediments, ranging in age from around 18 Ma to Middle Pleistocene and resulting from the erosion of the Himalayas, occur right from Pakistan in the west to Bhutan in the east. They have been finally uplifted in the most recent phase of Himalayan orogeny, in the middle of the Middle Pleistocene, and they form a hill range in-between the Himalayan Mountains and the Ganga Plain. With the uplift, faulting processes separated the Siwalik range from the Lesser Himalayas by a long inter-montane depression locally called "dun" and drained by different rivers. The sediments of these dun valleys and the terraces of the antecedent rivers flowing from the Himalayas into the Ganga Plain, postdate the uplift of the Siwalik sediments. Therefore the occurrence of Soanian in the dun valleys and terraces while the Acheulian is found in the areas of Upper Siwalik sediment exposure is most probably due to an older age for the Acheulian compared to the Soanian.

Mohapatra (1981) first suggested that the Acheulian was only found on outcrops of Upper Siwalik sediments or in the deposits of young streams eroding Upper Siwalik sediments. Following Mohapatra, further discoveries of Acheulian artefacts from areas where Siwalik sediments are exposed were reported (Corvinus 1990, 1995a, 1995b, 2007, Rendell and Dennell 1985, Singh *et al.* 1998). In reviewing the Indian Lower Palaeolithic, Gaillard and Mishra (2001) argued, based on the observations of Mohapatra and others, that the Acheulian and Soanian were not contemporary Lower Palaeolithic industries, since reported finds of Acheulian came only from areas were older sediments of the Siwalik formation were exposed.

This older age was already observed by the first investigators in the Potwar plateau (Teilhard de Chardin 1936, Teilhard de Chardin and de Terra 1936) and then confirmed by Rendell and Dennell (1985) for two sites, Dina and Jalapur on the Jhelum river where handaxes were found in tilted sediments, and so pre-dated the tilting estimated to have occurred before 400 kyr. Corvinus (1990, 2007) found 12 bifaces from the site of Satpati, in tilted sediments in Nepal, which she also inferred predate the last phase of Himalayan tectonics. The only Acheulian site in the Siwaliks from a post uplift context is Gadari, in the Dang dun valley of Nepal, where two handaxes were found overlying Middle Siwalik bedrock and overlain by Late Pleistocene colluvial silt. Rapid erosion of the silt seen presently makes it likely that these handaxes might have been derived from an earlier episode of sedimentation.

Atbarapur is in the piedmont zone of the sub-Himalayas, at the foothills of the Siwaliks facing the Ganga Plain (Fig. 1). The local outcrops are made of sandstones and loose conglomerates of mostly quartzite pebbles, cobbles and boulders probably belonging to the Pinjore Formation (GSI 1976). The artefacts occur in the choes (seasonal streams) and gullies. The neighbouring villages of Rehmanpur and Takhani have also yielded some Acheulian implements, but the Doonge Tote Wali choe, near Atbarapur, is the richest. Unfortunately (for archaeologists) the construction of a dam has now partly filled up the choe with silty-sandy deposits and significantly modified the local landscape. This choe starts in the Siwalik Hills and flows towards the Punjab plains; its course is of about 1.6 km. It is bordered by terraces on both sides just before it leaves the Siwaliks. The surface of these terraces is covered by thick vegetation of thorny shrubs and grass. At certain places the exposed stratigraphy of the terrace deposits is about 2.5 m thick and consists of 1.5 m of gravel at the bottom, covered by 1 m of loose silt and sand. From the gravel, a few cleavers and choppers were discovered *in situ* but most of the lithic artefacts were found lying on the surface.

Composition of the Assemblage from Atbarapur

The assemblage from Atbarapur is characterized by a majority of typical Acheulian tools, i. e. handaxes and cleavers (Table 1). Even if their relative quantity to the total collection has no statistical significance (sample sorted through natural processes), their proportion relative to each other may be more reliable and it is worth noting that the number of cleavers are much more than the

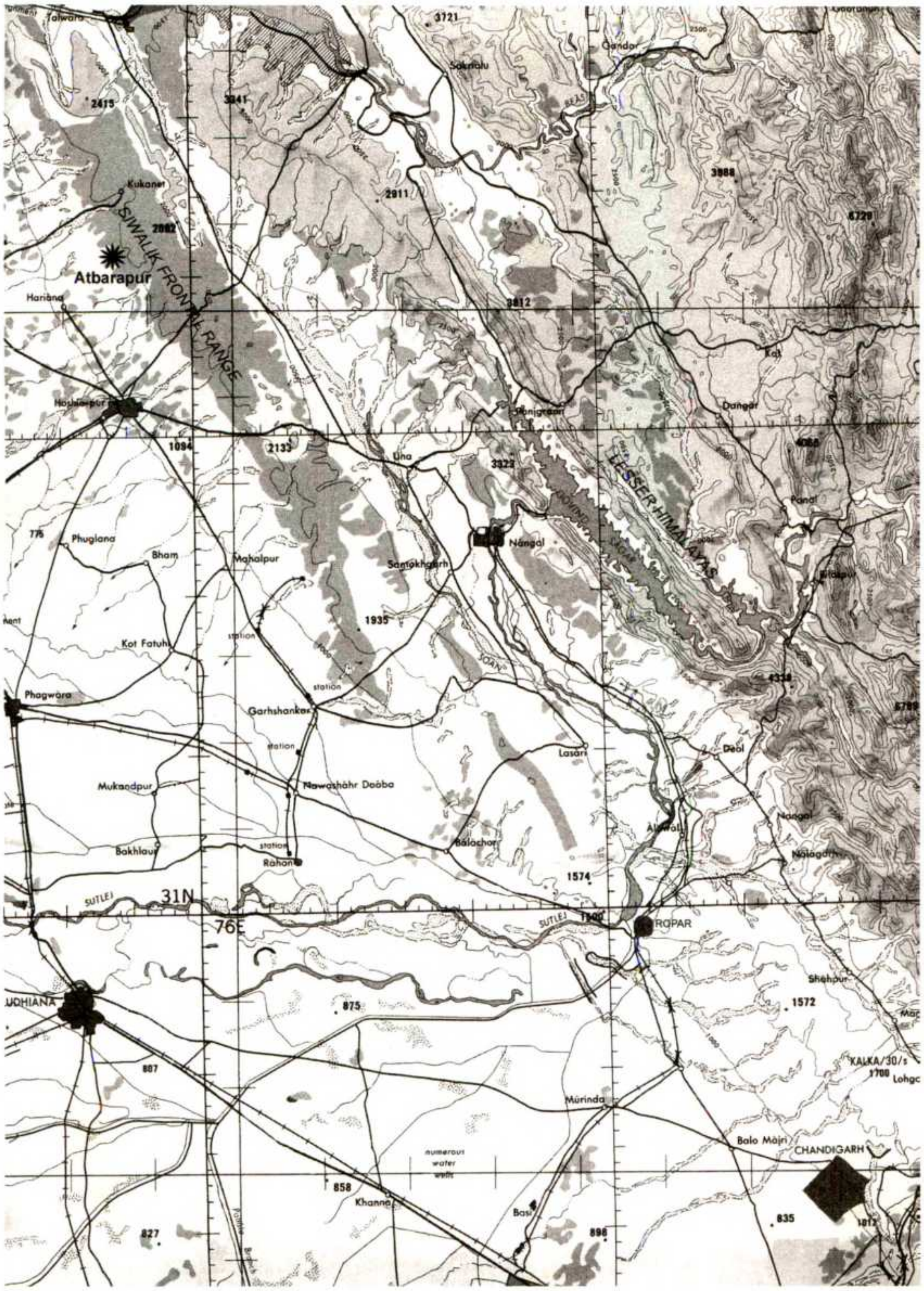

Fig. 1: Map of the Hoshiarpur Siwalik Range showing the location of Atbarapur and the other Acheulian occurrences

handaxes (37 and 15, respectively). Besides these Acheulian tools, made on large flakes, there are only a few other tools on flakes: - two knives (large backed scrapers), one scraper and one denticulate. Unretouched flakes represent a small group (10). The choppers, made on both flakes and cobbles, are as frequently represented as the cores, usually on cobbles (13 of each).

All these artefacts are in medium to fine grained quartzite, rather dark in colour (red, green, grey). In the Siwaliks, dark coloured quartzites are more metamorphised, silicified and homogenous than the light coloured ones and they were selected by prehistoric people for making their tools, *i.e.* Acheulian as well as Soanian. These rocks were available in the form of cobbles and

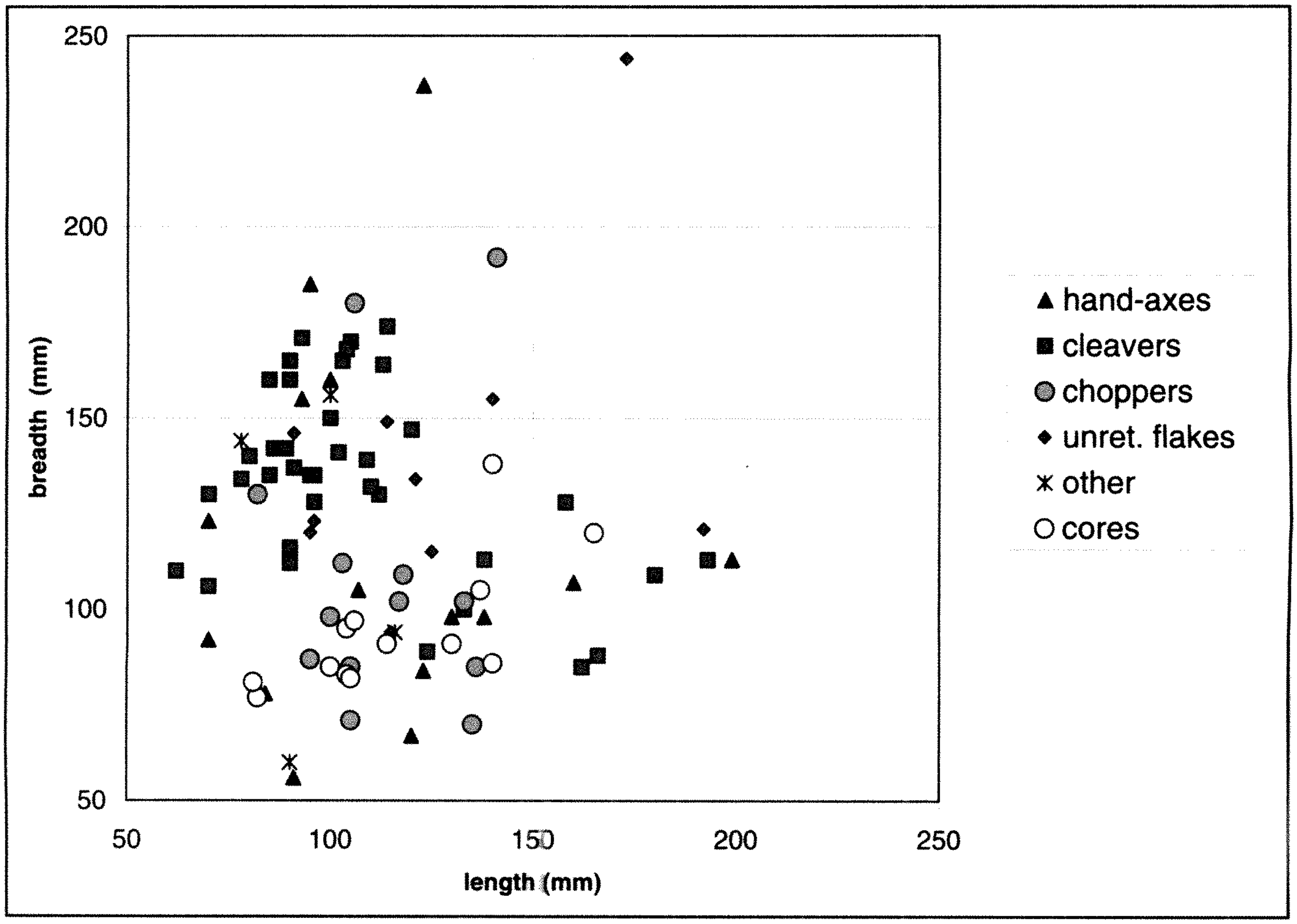

Fig. 2: Bidimensional diagram for length and breadth of the artefacts from Atbarapur according to their technical orientation

Table 1: Composition of the assemblage from Atbarapur

	Count	Percentage
handaxes	15	16
cleavers	37	40
knives	2	2
scraper	1	1
denticulate	1	1
unmodified flakes	10	11
choppers	13	14
cores	13	14
Total	**92**	**100**

Table 2: Dimensions (mean ± s.d.) of artefacts from Atbarapur according to the morphological orientation (in mm)

Artefact	n	Length	Width	Thickness
handaxes	12	140± 43	90±19	45±12
cleavers	37	145±21	96±15	44±9
Other tools on flakes	4	126±30	83±18	41±19
Unretouched flakes	10	150±40	116±25	46±13
Choppers	13	114±18	109±38	54±14
Cores	13	116±25	95±17	73±14

boulders, as it can be inferred from the patches of cortex remaining on the artefacts. At present, no such large rounded stones are visible at Atbarapur but they are reported in the surroundings.

The Atbarapur assemblage is quite homogenous, as far as size is concerned (Table 2) and this strongly suggests sorting according to size or weight, either due to some taphonomic process or due to anthropic process, resulting in a particular configuration of the original site. Large cores ("giant cores") expected to have produced the majority of the flakes are missing and the smaller flakes, produced by the cores and choppers of the assemblage are also missing. It is to be noted that the morphological measurements given in Table 2 do not consider the technological orientation of the artefacts (length = maximal dimension, breadth = maximal measurement perpendicular to the length): for the side struck flakes, the morphological length and breadth are inverted with the technological length and breadth. In this assemblage the longer tools are the handaxes and cleavers, as well as the unretouched flakes, while, with the exception of a few, the choppers and cores are shorter but thicker. Measurements taken with the technical orientation provide the same picture of dimensional homogeneity (Fig. 2).

Core Reduction Sequence

Flakes

In this collection of 92 items, 69 are primarily flakes, mostly retouched (85%), while the others are cobbles, often broken before flaking. One artefact may be made on a slab.

The large majority of the flakes (53/69, about 75%) are side struck or square (no distinction between side struck and end struck) and the end struck flakes are fewer in number (10/69) suggesting a particular way of flaking (6 flakes are undetermined due to extensive trimming). The average maximal dimensions of both types of flake however do not differ much (141 mm and 136 mm; Table 3).

Table 3: Dimensions (mean ± s.d.) of the flakes from Atbarapur according to their technical orientation (in mm)

Artefact	n	Length	Width	Thickness
All flakes	69	107±42	130±35	45±11
Side struck flakes	53	104±29	141±31	46±12
End struck flakes	10	136±32	99±22	44±11

Striking platforms are fully cortical for more than the half of the identifiable specimens (28/50, excluding the 19 undetermined); while the others are usually completely devoid of cortex (13 have plain and 7 have dihedral platforms) and only rarely partly cortical (2 dihedral platforms).

Usually the percussion point appears in the middle of the ridge between the striking platform and the flaking surface (34) but sometimes it is in the angle (15) or in between the middle and one of the angles (8); others are undetermined. This indicates that quite often the percussion was applied near the corner of the face used as striking platform; and that the flakes were removed along the border of the exploited surface. This method of striking would mostly produce *"débordant"* flakes with a back, which hardly needed to be worked for making a cleaver. Apparently there is no link between the position of the percussion point and the flake morphological elongation.

The dorsal face of the flakes is entirely cortical in a number of cases (20/69). When the striking platform is also cortical (9/20) it indicates that the flakes were the first to be detached from the boulders or cobbles that were selected as cores. When the platform is not cortical (only 2/20, the other ones being undetermined) the stroke was applied on a previous flake scar or fracture. Besides these entirely cortical ones, only a few flakes show a cortical zone extending on more than the half of the dorsal face (6/69) or slightly less than the half (4/69). Many flakes (15/69) only bear small patches of cortex that is less than one fourth of the dorsal face or, more often, that forms a cortical back (steep side). Most of the flakes have no cortex at all (23/69).

A number of these flakes with no cortex or with very little cortex are Kombewa flakes (16/69), in a broad sense, *i.e.* struck from the ventral face of a larger flake or from the flat surface of a split boulder, both being often confusing since the ventral face of the flakes is usually almost flat with a diffuse bulb. For half of them (7) the percussion was in the same direction as the one having produced the larger flake-core; only 2 are perpendicular (others undetermined).

Most of the flakes show 1 previous flake scar (13 ordinary flakes and 4 Kombewa flakes) or 2 scars (8 ordinary flakes and 1 Kombewa). Only a few bear 3 to 5 previous flake scars (Table 4), suggesting that they were struck from a core that had already produced several flakes. Since the previous scars (representing the flakes previously removed from the core) are few, the flakes of the Atbarapur assemblage seem to correspond to the beginning of the core reduction sequence; but it must be kept in mind that the later scars can hide some of the earlier ones.

The flakes are relatively large in size. They may well have been produced at the beginning of the reduction sequence and later on, when the cores, more exploited, were getting smaller, the flakes would also have been reduced in size. This part of the sequence, producing

Table 4: Number of flake scars versus extent of cortex on the dorsal face of the flakes from Atbarapur (ordinary flakes + Kombewa flakes marked "K")

Extent of cortex	Number of flake scars							
	0	1	2	3	4	5	undet.	Total
no cortex	6K	4+2K	5+1K	1	1	—	3	14+9K
< 1/4	5K	3+2K	1	1	1	1	1	8+7K
1/4 to 1/2	—	3	1	—	—	—	—	4
1/2 to 3/4	—	3	1	1	—	—	1	6
fully cortical	20	—	—	—	—	—	1	21
Total	**20+11K**	**13+4K**	**8+1K**	**3**	**2**	**1**	**6**	**53+16K**

smaller flakes, is absent at Atbarapur. Either such flakes were never produced at the original living site and/or workshop, or they are missing due to removal by some taphonomic factor.

The pattern of the flake scars is visible on 26 flakes only. On many of them, the scars show the same flaking direction as the considered flake (11) indicating that the same striking platform was used for all the removals. Sometimes the direction of all the scars is perpendicular (5) or opposite (2) to the flaking direction of the flake itself. When the scars have different directions, they can be perpendicular to each other (4) or opposite (2) or "crossed" with more than two directions (2). This suggests that different faces of the core were used as striking platforms; but there is no proper convergent flaking linked to definite control of the flaking surface convexity.

These debitage products (flakes) appear to result from a rather simple core reduction sequence. The first flakes represent at least 1/8 of the products and slightly more than 1/6 of the non Kombewa products. Therefore, if the Atbarapur assemblage was a good random sample, statistically representative of the production at the original site, this would suggests that each cobble or boulder core had provided 6 or 7 flakes. According to the observed proportions, these 6 or 7 flakes would include 1 first flake, 1 or 2 flakes with a largely cortical dorsal face, 2 or 3 flakes with a small patch of cortex and 2 flakes without cortex. Such a combination fits well with the pattern of a short sequence of production, which is also the production of large size items. It seems quite possible that the collection from Atbarapur may actually be representative of the large-sized debitage, that was originally produced during the first stages of the core reduction sequence from boulders in order to acquire large flakes.

The specificity of this debitage is the high proportion of side struck flakes, which may indicate that no attention was paid to the longitudinal convexity. But this is also a simple and convenient method for obtaining a wide cleaver cutting edge, on the lateral side of the flake, formed by the previous removal from the same striking platform (unipolar exploitation of the core). The percussion point at the angle of the flakes, for 1/4 of them, remains to be understood through more detailed observation and experimentation; it may just be the continuation of the same process up to the end of the striking platform. The use of the ventral face of a larger flake (Kombewa method) or of the split surface of a boulder as flaking surface (1/4 of the production), may be advantageous for getting large cutting edges. Therefore, although simple, the core reduction sequence was oriented and adapted to the production of blanks for manufacturing cleavers.

Cores

A first look at the 13 cores of the Atbarapur assemblage clearly shows that they have nothing to do with the flakes described above. All of them still bear some patches of cortex attesting that they are river cobbles or boulders. A few of them (at least 4) keep enough of their original shape and volume to show that they actually were cobbles (6 to 25 cm) rather than boulders (> 25 cm). As for the other ones, the convexity of the cortex remnants suggests that they were probably cobbles too. Moreover as their dimensions are smaller than the flake dimensions (Tables 2 and 3), it is clear that none of these cores were used for the production of the flakes of the Atbarapur assemblage. They correspond to another production sequence, oriented towards smaller flakes that are unfortunately missing here, probably due to sorting during the process of re-deposition.

It seems that some of these cobbles have been intentionally split into two parts before being turned into cores as they show remnants of flat or slightly convex surfaces in between the concave removals. A few of them may be flakes proper, turned into Kombewa cores but the removals hinder us from knowing whether the flaked surface was a proper bulbar ventral face or just a split surface.

The exploitation of these cores is organised into two surfaces showing a large range of convexities, from flat to nearly conical. All the cores are bifacial or partly bifacial and there are no polyhedral cores with multi-facial flaking. The total number of observable flake scars does not exceed 10 for both the faces (except for one core with 13 scars); the average is 7.3 scars per core that may be quite close to the number of flakes obtained from each core, since none of them seem to have been intensively exploited. The scar pattern is mostly unidirectional, but sometimes also bi-directional or crossed (multidirectional but not properly convergent). It is to be noted that both the faces are unequally exploited; on some of the cores, the less exploited face just shows a few isolated flake scars, used as platform for striking flakes from the other face. This suggests that both faces do not play the same role in the core reduction process. But this organisation is not general and it also happens, especially when the number of flake removals increases, that the less exploited, more cortical and more convex face bears the last removal/removals, the more productive face being then taken as the striking platform. Sometimes the cortex (neocortex resulting from river wearing) is simply used as the striking platform; this is rare for the visible removals but it might have been the rule for the first one(s).

According to the degree of exploitation and the convexity of each face, these cores have different morphologies, from chopper like cores to almost discoidal cores (Fig. 3). The concept of core reduction recalls that of chopper trimming: flaking from the edge towards the centre by striking on a preliminary removal or sometimes directly on the cortex, and proceeding that way along the periphery, on a small or longer stretch but rarely on the total periphery.

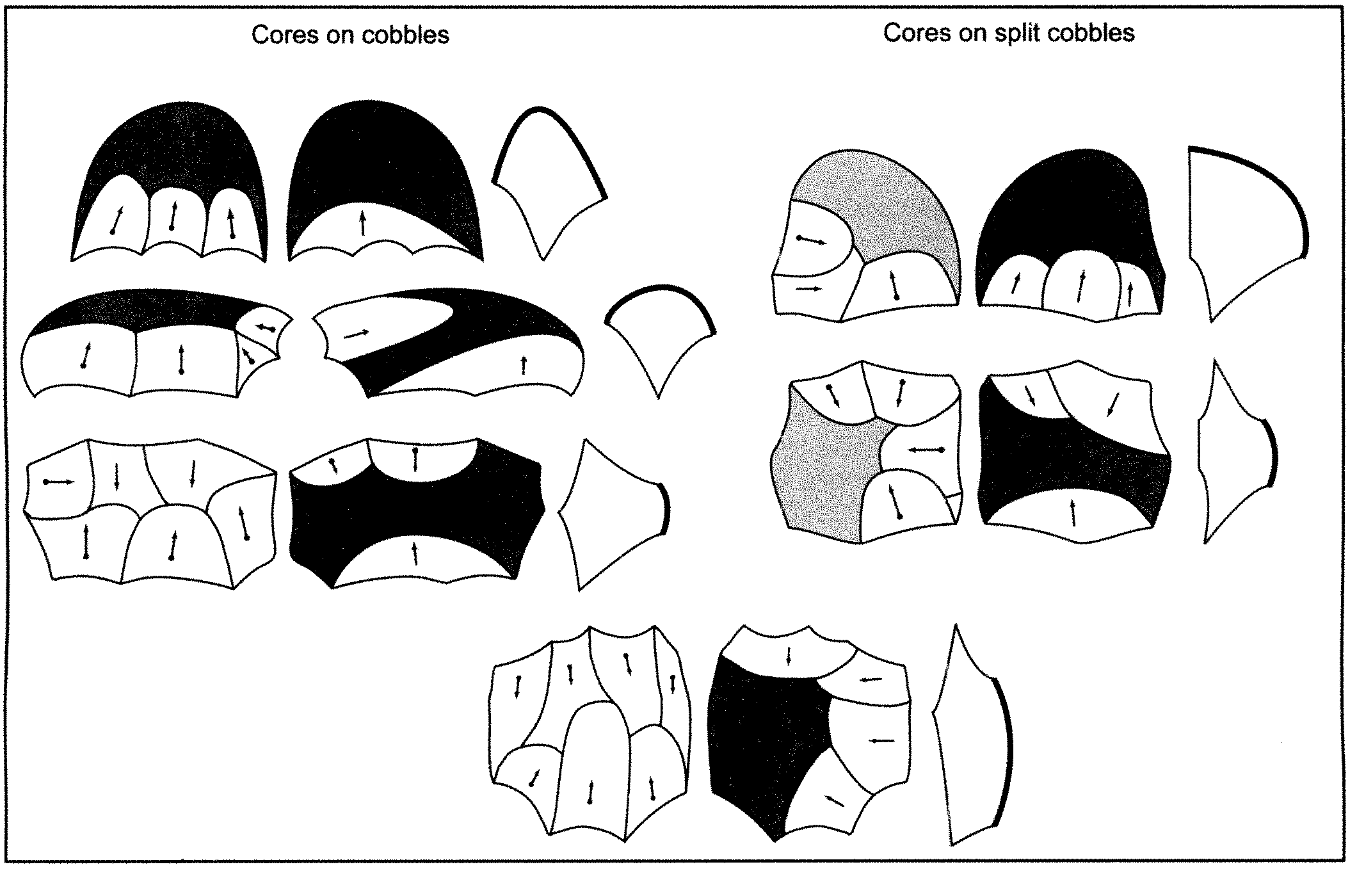

Fig. 3: Schematic core reduction sequence at Atbarapur

Some of these cores may be confused with bifacial choppers (chopping tools), but since their edge, formed by the flake removals, is not regularised by retouching, they are considered to be cores. However they may show, as some of the other cores in this assemblage, chipping of the edges (5/13) or crushing marks (1/13) or both (1/13), suggesting they were utilised as tools (these marks probably do not result from natural agents, since the artefacts are imbedded in sand or fine gravel).

Reconstruction of the Processing Sequence

Within the assemblage recovered from Atbarapur, the flakes are in average bigger than the cores (Table 2). Therefore the former do not result from the reduction of the latter, or they only represent the first stage of their reduction sequence, when the products are of the largest size. But in the assemblage from Atbarapur, there is neither any exhausted core nor any core showing intensive exploitation, possibly deriving from a big core having previously provided large flakes. Moreover, the study of the cores shows that all of them were probably cobbles at the beginning of the reduction sequence and already smaller than the large flakes. Therefore these flakes cannot correspond to the first stage of exploitation of the cores from Atbarapur. They were definitely produced from other larger cores.

Meanwhile the method of flaking is quite similar for both types of production. The analysis of the flakes suggests 6 or 7 products for each boulder or cobble core and the studied cores shows an average of 7 scars, involving an average production of 7 to 9 flakes. The flaking directions are, both on flakes and cores, mostly unidirectional, sometimes perpendicular or crossed. There is neither preparation of the striking platforms nor of the flaked surfaces and this is clearly visible on both the flakes and the cores. The Kombewa method proper might have been used but the flakes with two "ventral faces" may also have been struck from the nearly flat face of split boulders. Actually no Kombewa cores are clearly identifiable in the assemblage, while split cobbles are well represented; if the same core reduction method was applied, right from the beginning, to both large and small productions, splitting might have been applied to the boulders, except if their bigger size makes it much more difficult than for the cobbles.

Therefore it seems that the large and small flakes were both produced at the original site and, right from the beginning, the cores were selected according to the desired size of the flakes that were to be produced (or inversely). Both groups of cores were processed in the same way, following a simple and short sequence (mostly less than ten flakes per core; Fig. 3).

Trimming of the Tools

Handaxes

Among the 15 handaxes, 11 are proper handaxes (2 of them being broken near the tip), 2 are partial handaxes, bifacially retouched on one side only, one is atypical, retouched on the margins only, and one is strictly unifacial, oval in shape, resembling a small "sumatralith" (typical Hoabinhian tool in South East Asia).

All these handaxes are made on flakes, except one that is possibly made on a small slab, if not on a flake, and one whose blank is undetermined and without any cortex. Therefore none of these tools were made directly from cobbles. When the flakes used as blanks still keep their striking platform or some technological orientation mark, they appear as side struck flakes more often (6/13) than end struck flakes (2/13), but undetermined flakes are not negligible (5/13). Only 4 striking platforms are preserved (others are removed by retouch): 3 are cortical and one is without cortex. When visible, the percussion point is more often at an angle (4/13) than in the middle (2/13). The dorsal face is variable: it is either without cortex (5/13) or with very little cortex (usually on a back; 2/13), but is also entirely cortical (3/13) or partly cortical (3/13). It is to be noted that unlike the cleavers no Kombewa flake is identifiable among the handaxes.

The extent of the flake scars trimming the blanks into handaxes never covers the entire face, except for one of these tools, which is at the limit between handaxe and core, and shows a face entirely covered by flake scars. Apart from it, trimming generally extends on about half of each face, slightly more on the ventral face than on the dorsal face (Table 5). Usually 2 generations of retouch can be observed (8/15), the second one regularising the edge shaped by the first one. A few handaxes (4/15) are trimmed by one generation of flaking only; some other ones (3/15) are more carefully worked and show 3 generations of flake scars.

The overall shape of the handaxes from Atbarapur is either amygdaloid (6/15) or oval (6/15), except for 1 handaxe-cleaver having a trapezoidal shape (and 2 broken specimens).

It is to be noted that none of them is properly pointed. All the tips are more or less rounded (7/15) or they are cutting edges (2/15) or short steep edges (2/15), the other three being broken. Some of these tips are even not trimmed (5/15). When trimmed, the retouch is rather unifacial (3 inverse, 2 direct) than bifacial (2/15). But use marks are very common in the form of chipping, either on both faces (6/15) or only one face (ventral 3/15, dorsal 1/15). One of the tips also bears a crushing mark.

The butt of the handaxes is unworked for half of them (5/15) and otherwise it is trimmed by unifacial inverse (5/15) or bifacial (3/15) retouch; two specimens have no butt as they are broken. The shape of the butt is usually a steep back either cortical (4/15) or non cortical (3/15); it can be trimmed into a thick cutting edge or bevel (2 cortical with inverse retouch, 2 non cortical with bifacial retouch) or a sharp cutting edge (1 with bifacial retouch) or even be pointed (the handaxe-core). The butts seem to have been utilised too, as they show some chipping either on both faces (2/13) or on the ventral face (3/13) or dorsal face (1/13); crushing marks occur on one of the unretouched steep cortical butts.

Most of the lateral edges of the handaxes are not sharp and instead of cutting edges they are named "bevels" (angle between *ca.* 55° and 80°); only 2 specimens have sharper edges. They are usually bifacially trimmed on both sides (11/15) but 3 of them have only one bifacial edge, the opposite one being unifacially worked, and, as mentioned above, one is strictly unifacial.

The handaxes from Atbarapur (Fig. 4) are made on large flakes, which are not much modified by the flaking which hardly covers more than half of each face. Therefore these tools result from a limited work and the points are not especially trimmed: they appear to be just the continuation and junction of the edges. If the chipping of the edges results from utilisation, it suggests that these tools were utilised in many ways since it occurs on different parts of the edges, preferentially on the cutting edges but also on the backs (steep edges), whatever their location is (lateral sides, tips or butts).

Cleavers

The cleavers (Fig. 5) represent the most important component of this assemblage and it is worth noting that they are more than double the number of handaxes. Almost all of them (32/37) are made on side struck flakes, only a few being on end struck flakes (3/37) or undetermined flake (1/37); one is on a split cobble. Striking platforms are as often cortical (9/36) as non cortical (10/36); dihedral platforms are quite common (6 without cortex and 1 partly cortical) and there is one linear cortical platform (stroke applied on a ridge of the core). The others are removed by trimming. The percussion point is mainly in the middle (18/36), otherwise it is at an angle of the flaking face (8/36) or in between (6/36). The dorsal faces of the blank flakes are often entirely cortical (14 including the split cobble), providing cleavers classified as "type 0" (Tixier 1958). But most of the blanks are without cortex (13/37) or with a small cortical patch, often as a steep edge/back (10/37). Among the latter, the Kombewa flakes or flakes from split boulders are the majority (12) either without cortex (7) or with a cortical back (5). As mentioned above, the Kombewa flakes are absent in the handaxe group. Actually such flakes usually offer a sharp cutting edge on a greater part of their periphery and they are ideal for making cleavers, whereas they do not fit the pattern of handaxes.

Table 5: Extension of the trimming on each face of the handaxes from Atbarapur

Ventral face	Dorsal face						
	0	< 1/4	1/4 to 1/2	1/2 to 3/4	> 3/4	Entire	Total
< 1/4	—	1	—	—	—	—	1
1/4 to 1/2	—	—	2	1	1	—	4
1/2 to 3/4	—	—	4	2	—	1	7
> 3/4	1	—	1	—	1	—	3
Total	**1**	**1**	**7**	**3**	**2**	**1**	**15**

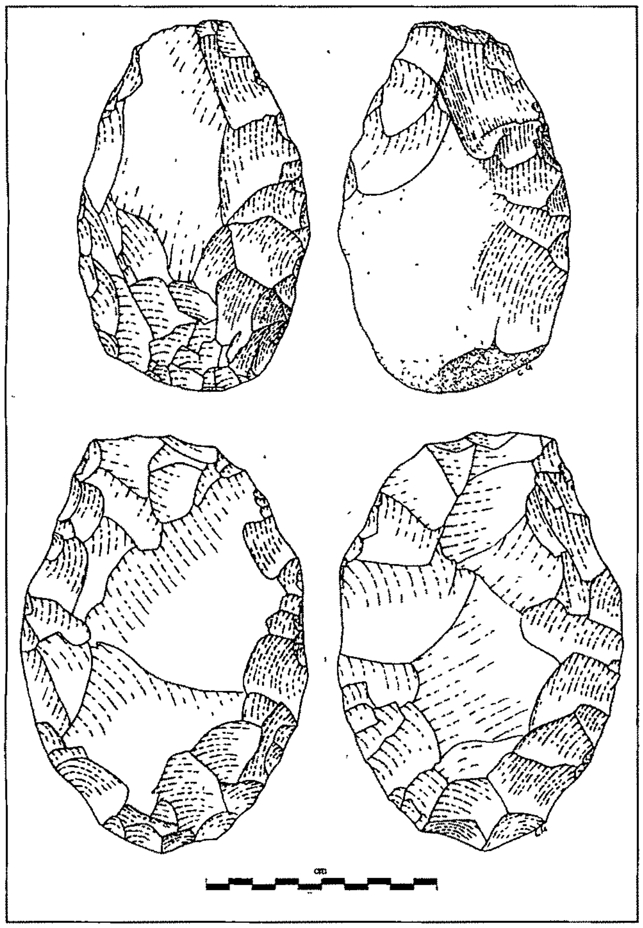

Fig. 4: Handaxes from Atbarapur

The cleavers are usually trimmed on the margins only; however the retouch can extend up to half of each face and sometimes extends even further, especially on the ventral face (Table 6). This may be related to the thinning of the bulb. For half of the cleavers (18/37) the trimming consists of just one generation of retouch, without further regularisation of the edges (which are not supposed to be working edges). The other ones show 2 generations of retouch (15/37) and rarely more (4/37). Therefore, the original shape of the blank flakes is hardly modified. The outlines are mostly trapezoidal (14/37) or rectangular (9/37) or oval (7/37).

By definition, the cleavers are characterised by a cutting edge that is unretouched. It is supposed to be the main functional part of the tool, but the other edges may be utilised too. At Atbarapur the cleaver edges are all slightly convex and most of the time both their faces are devoid of cortex (26/37); but there are also a good number of cleavers whose cutting edge is along a cortical dorsal face (11/37). The location of the cutting edge, relatively to the technical orientation of the blank flake, is more often on the left side (22/37) than on the right side (9/37), while the other ones (6/37) are on the transversal edge. Even though the difference between left and right appears quite high, it is not significantly deviant from an even distribution, according to the chi-square test (chi-square = 1.74 < 3.84 for d.f. = 1 and 0.05 level of significance).

Utilisation is suggested by chipping of the edge, either on both the faces (16/37) or on one face only and in that case the ventral face is more often damaged than the dorsal face (10 and 4 respectively, no chipping being observed on the cortex along the edges). There are a few edges without use marks (7/37).

The butt opposite to the cutting edge is a bevel (open angle edge) in most of the cases, otherwise it is a steep edge (or back) and rarely a cutting edge. These different butt morphologies, from steep to sharp, are either cortical or non cortical, and trimmed or untrimmed (Table 7).

The cleaver butts are sometimes damaged (= used?) what ever their form is, but provided they are devoid of cortex (except one butt that is a cortical cutting edge). These marks take the form of chipping (8 bifacial, 4 direct, 4 inverse) or crushing (2). It seems there is no link between the damage of the cleaver cutting edge and that of the butt. Anyway, if these damages are due to utilisation, they show that the sharp cutting edge of the cleavers is not the exclusively active part of these tools.

All the lateral sides of the cleavers are trimmed, except 4 (1 on the left side and 3 on the right side). This trimming is independent of the original morphology of the sides and does not modify them much. Most of the sides are either steep, making a back (all together, 26/74 without cortex, 4/74 cortical) or oblique, making a bevel (22/74 without cortex, 6/74 cortical); they are rarely sharp (6 and 3/74). The trimming is bifacial for half of them (38/74; Table 8) but only 13 cleavers show bifacial trimming of both their sides.

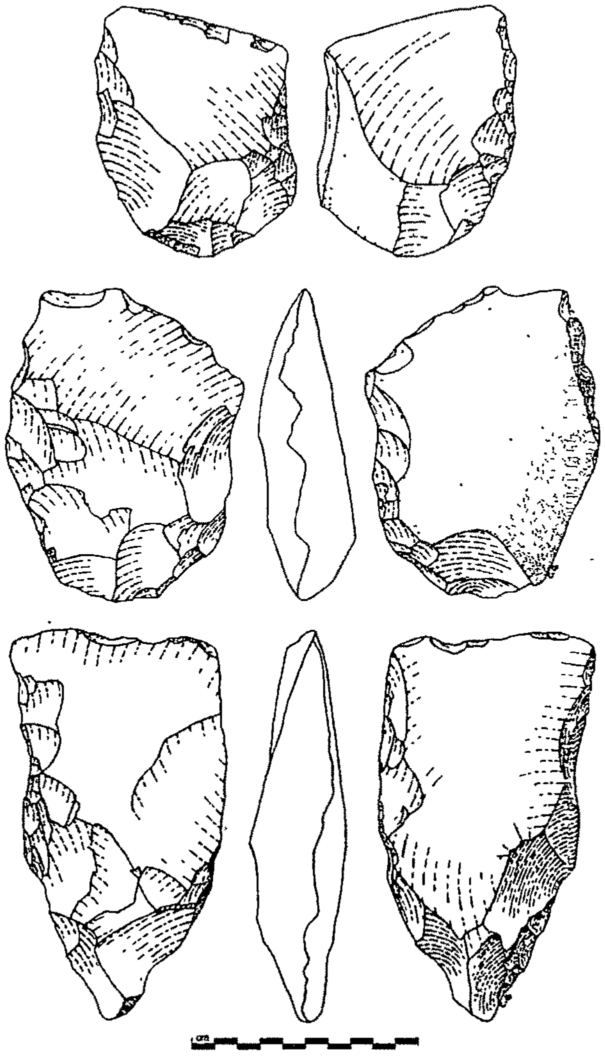

Fig. 5: Cleavers from Atbarapur

Damages are quite common on the lateral sides of the cleavers, especially chipping (only 3 crushing marks). They occur on both sides (13/37) or on one side only (10/37); but some specimens do not show any (14/37). The lateral and proximal sides appear to have been damaged whatever their shape is.

Choppers

The question often arises of whether the choppers are implements or cores. As already mentioned regarding the cores, the regularity of the edge helps in distinguishing between the two. In the assemblage from Atbarapur, 13 choppers were identified and among them 6 are made on flakes and 5 on cobbles. Some of these cobbles may be preliminary broken. As for the flakes, all are side struck except one; they mostly have a cortical platform (4/6) and their dorsal face is either entirely cortical (3) or partly cortical (1) or with a cortical back only (1 Kombewa flake) or without cortex (1). Therefore, half of the choppers are made on blanks that show the same technical characteristics the cleavers.

Trimming of the choppers is mostly unifacial (8/13) but on a few of them this unifacial trimming changes its direction at places, upwards/downwards (2/13). Strictly bifacial trimming (chopping tool) is rare (3/13). In half of the cases (7/13), the trimming results from one generation (one series) of retouches, and for the other ones a second generation of retouches makes the edge more regular and even. On the unifacial choppers, the trimming sometimes spreads on more than half of the face area (5/8), but on the bifacial ones, this happens only when the other face shows a minimal trimming, less than 1/4 (2/5). The pitch of the choppers edges varies widely from cutting to steep.

Conclusion

Although it is not in a primary situation, the assemblage from Atbarapur includes a set of artefacts which, altogether, are very informative regarding the technical behaviour of the Acheulian people who made and used them. It is composed of large flakes (nearly 140 mm long in average) on the one hand, and cores and choppers on the other hand, both having almost the same size. They correspond to two parallel reduction sequences, following the same modalities, but one uses boulders as cores (absent at the site) and the other one uses cobbles (from which the flake products are missing). Apart from the cores and half of the choppers, the whole assemblage is made on flakes, the majority of them being trimmed into cleavers and handaxes.

Table 6: Extension of the trimming on each face of the cleavers from Atbarapur

Ventral face				**Dorsal face**		
	0	**< 1/4**	**1/4 to 1/2**	**1/2 to 3/4**	**> 3/4**	**Total**
0	—	2	1	1	—	4
< 1/4	—	3	5	3	—	11
1/4 to 1/2	2	4	2	—	2	10
1/2 to 3/4	1	3	5	1	1	11
> 3/4	—	1	—	—	—	1
Total	**3**	**13**	**3**	**5**	**3**	**37**

Table 7: Relation between morphology and trimming of the cleavers butt from Atbarapur

Morphology			**Trimming**		
	bifacial	**direct/up**	**inverse/down**	**nil**	**Total**
back, cortex	1	3	—	3	7
back, no cortex	4	—	2	1	7
bevel, cortex	—	—	2	3	5
bevel, no cortex	8	3	1	—	12
cutting edge, cortex	1		1	—	2
cutting edge, no cortex	1	1	—	2	4
Total	**15**	**7**	**6**	**9**	**37**

These features are very significant in the context of the Siwaliks, where most of the sites yield Soanian assemblages, composed of choppers and a few cores on cobbles, as well as flakes resulting from their shaping or exploitation. There are no handaxes or cleavers, and large flakes are usually absent in the Soanian assemblages.

The production of large flakes seems to be an important character of the Acheulian technical tradition or "Mode 2", throughout the world. In India, such large flakes may be obtained from various types of materials, occurring in different ways. It may be quartzite quarried from the outcrops, close to the site, as in the shelter IIIF-23 at Bhimbetka (Misra 1985), or silicified limestone quarried at the site itself, as in Isampur (Paddayya *et al.* 1997, 1998, 2006); it may be basalt flaked from boulder sized nodules (resulting from spheroidal weathering), as in Morgaon (Maharashtra; Mishra *et al.* in press) or dyke basalt flaked from blocks of the weathering outcrop as in Chirki on the Pravara (Corvinus 1983), or quartzite from boulders and cobbles, as in Atbarapur, or in the Narmada valley, or also in Attirampakam (Tamil Nadu; Pappu 2001, Pappu and Kumar 2006) as well as in many sites in peninsular India.

Anyway, the lack of boulders or large blocks, hence of large flakes, never hinders the prehistoric craftsmen from making handaxes, while cleavers become difficult to produce. Actually many Acheulian assemblages comprise handaxes on cobbles or nodules. The most significant example is that of all the Lower Palaeolithic sites in the Somme-Seine-Thames basin (including Saint-Acheul) in north-western Europe, where the handaxes are made from flint nodules and where the cleavers proper (on flakes) are absent (yet some handaxe-cleavers show morphological convergence with cleavers but are obtained with a different shaping method). In Peninsular India, many sites yield handaxes on nodules, like Bori (Maharashtra; Mishra *et al.* 1995), Renigunta (Andhra Pardesh; Gaillard and Murty 1988, Gaillard *et al.* 1990), or on slabs, like Singi Talav at Didwana (Rajasthan; Gaillard *et al.* 1983, 1985, 1986). Actually the large diversity of Acheulian assemblages may be linked to the variety of the raw materials, in nature and shape. However this diversity does not go beyond a certain limit an even from a diversified raw materials, the Acheulian tool makers could produce rather standardised implements (Sharon 2008).

Considering the geographical situation of Atbarapur, between the Indo-Gangetic plain and the Himalayan range, it would be very interesting to find in this site some indication related to the possible diffusion routes of the Acheulian from Africa to East and Southeast Asia, if at all the Acheulian phenomenon is a matter of diffusion and not a matter of polycentric inventions (as suggested by Boëda 2005). In the most common hypothesis of cultural and technical diffusion, or even migration of people bearing the Acheulian tradition, the coastal plains would have been the easiest way, either through the Arabic peninsula, by crossing the Bab el Mandab and Ormuz straights (Petraglia 2003, 2005), or through the Levantine corridor, where Acheulian sites are well represented at early dates, as for

Table 8: Relation between morphology and trimming of the lateral sides of the cleavers from Atbarapur

Morphology			**Trimming**		
	bifacial	**direct/up**	**inverse/down**	**nil**	**Total**
back, cortex	—	3	1		4
back, no cortex	14	3	8	1	26
bevel, cortex	—	1	4	1	6
bevel, no cortex	15	5	2	—	22
cutting edge, cortex	1	1	1	—	3
cutting edge, no cortex	5	—	—	1	5
miscellaneous	3	3	—	1	7
Total	**38**	**16**	**16**	**4**	**74**

instance Ubeidiya (Bar-Yosef and Goren-Inbar 1993) and Gesher Benot Ya'aqov (Goren-Inbar *et al.* 2000). But another route, in slightly higher latitudes and altitudes, might have been a good alternative, as further east the upland environment seems to be quite favourable to human occupations (Schepartz *et al.* 2000). However it should be borne in mind that at the time when Acheulian people where living in the region of Atbarapur, *i.e.* before the post-Siwalik tectonic phase, the local landscape was very different, since the Siwalik hills did not exist. They occupied the sector, at least from the Jhelum valley (sites of Dina and Jalalpur, Rendell and Dennell 1985) to Nepal (sites of Gadari and Satpati, Corvinus 1990, 1995b, 2007) and they left single artefacts at many places along the Siwaliks of North-Western India (Singh in press). Lack of link evidences with the West (Levant) and the East (Bose basin in China) may just be the result of less research in the field and it is not sufficient for supporting the absence of cultural/technical continuity. The Acheulian large cutting tools from Atbarapur, mainly made on large flakes, compare well with those from GBY and from many sites in Africa (Sharon 2007), but they differ significantly, as far as the tool blanks are concerned, from those found in the Bose basin, which nonetheless have a lot of similarities with any Acheulian assemblage mainly made from cobbles (Xie and Bodin 2007). In any case, more sites are needed for implementing the discussion regarding the dispersal, diffusion or polycentrism of the Acheulian.

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The Upper Palaeolithic 'Damin Industries' of the Bansloi River Basin, Jharkhand

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Abstract

This paper presents a re-examination of the Damin complex of Upper Palaeolithic industries, Jharkhand. Recent field investigations led to the discovery and study of sites in different sedimentary contexts, and aided in the documentation of raw material sources, Studies of the lithic reduction sequence, and assemblage variability between sites helped in examining some aspects of prehistoric mobility patterns. The study also led to the first identification of pre-Upper Palaeolithic artefacts in this region, occurring within a stratified context. The Damin assemblages are also situated within the context of Terminal Pleistocene assemblages of Eastern India.

Introduction

In the early 20th century, observations by Anderson (1917) hinted at the presence of an Upper Palaeolithic phase in Bihar. Almost a century of subsequent research in this region resulted in the documentation of numerous sites assigned to the Upper Palaeolithic phase. An important complex of Upper Palaeolithic sites, termed the Damin industries, was first documented by Chakrabarti (1986, 1993) in parts of the Pakaur, Dumka, Godda and Sahibganj districts of Jharkhand. This paper reinvestigates the Damin Upper Palaeolithic sites of Jharkhand, provides a detailed description of the lithic assemblages and technology, and examines inter-and intra-site variability in assemblage structure. It also attempts to place them within a proper stratigraphic framework and to examine site contexts. This work also attempts to situate these industries within the wider context of assemblages which have been termed Upper Palaeolithic and microlithic in Eastern India (Kumar 2005a). In the light of recent developments in the discipline, the origins and nature of the Upper Palaeolithic in India requires to be re-examined (James and Petraglia 2005; Mishra 1995), and intensive regional studies and attempts to obtain better chronological resolution are perhaps the need of the day.

This region was previously explored by Chakrabarti (1986, 1993: 98-115). This work, as he himself admitted (1993: xi), was limited, forming part of a broader research project; but provided a solid framework against which the present study could be undertaken. The region was referred to as Damin-i-koh or "the skirts of the hills" by British administrators in the 19th century; hence Chakrabarti (1993: 102) termed the Upper Palaeolithic industries which were located within this region, as the Damin industries. He classified the Damin industry as an 'Upper Palaeolithic industry with microlithic elements, which occurs in a well defined stratigraphic situation and is marked by the almost exclusive use of a patinated brownish cherty material as raw material', (Chakrabarti 1993:102). He suggested that the Damin industry was an incipient blade industry with an element of burins, a predominance of retouched flakes, cores and scrapers, and with few blades (Chakrabarti 1993: 102; Kumar 2005a). A review by Narayan (1996:263), contrasted these industries with those from Singhbhum, Palamau, Hazaribagh and Giridih. Recent studies provide an overview of the prehistory of Jharkhand (Bhengra 2007).

Aims and Methods of the Present Study

Changing concepts of what constitutes the Indian Upper Palaeolithic, and a wealth of new dates and new approaches in lithic technology called for a fresh study of this region and its position in the wider context of the Indian Palaeolithic. The principal aim of this work was to derive some understanding of prehistoric behaviour patterns from a study of the nature and context of sites; lithic reduction sequences, and assemblage variability. Another aim was to investigate the unique nature of the Damin industry with its predominance of tools on flakes, and presence of a microlithic component. This resulted in the need to look for Lower and Middle Palaeolithic as well as Holocene microlithic industries in the region, in order to be able to situate the Damin complex in a broader perspective (Kumar 2005a).

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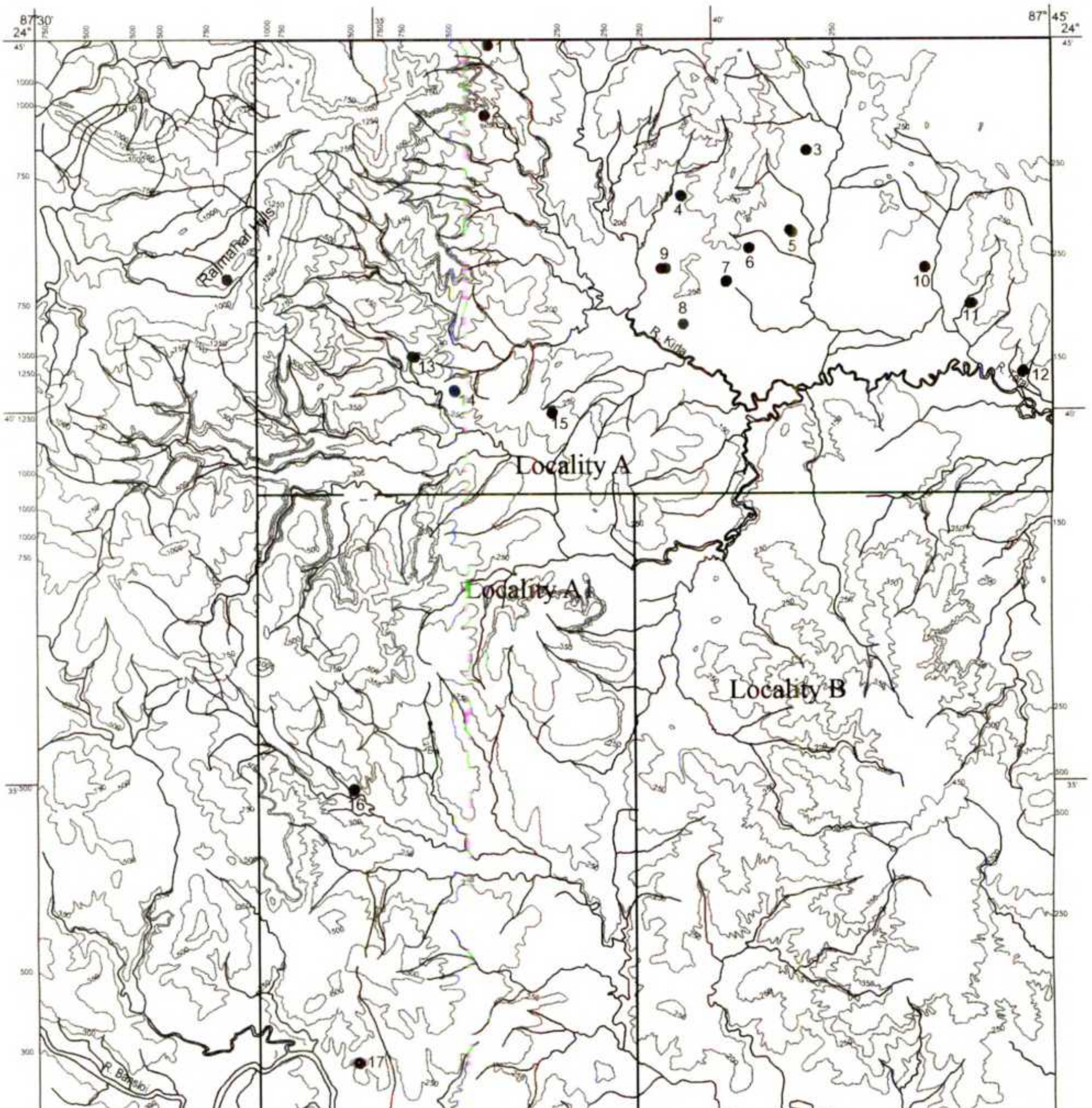

72 P/10

Locality A, A1:Intensively surveyed, Locality B: moderately surveyed (no sites)

The numbers indicate main loaclities, each of which may have a cluster of 'sites' or artefact scatters across the landscape

0 1 2 3KM

Key:

1. Gamaria
2. Dohari Pahar (Do Pahari)
3. Binjha Mahal
4. Asanbani
5. Taljhari
6. Kariodih
7. Jhenagaria
8. Karanghati
9. Ranga
10. Tarapur
11. Ghagorjani
12. Ramnathpur
13. Nipania
14. Kumarbag
15. Chitlo
16. jitko
17. Amrapara

Sites no. 18, 19, 20: Digri, Sonajori and Ilami are in Toposheet 72 P/14

Fig. 1: The study region showing distribution of sites

Although the Damin region classified by Chakrabarti, covered a broader area comprising the districts of Dumka, Pakaur, Godda, and Sahebganj in Jharkhand, it was decided to choose a compact region, following broad natural boundaries. The study region (24°30' to 24°45' N; 87°34' to 87°45'E), is a part of the Bansloi river basin, in the Pakaur and Dumka districts of Jharkhand, covering an area of 195.6 km^2. The region is bounded by the Rajmahal Hills in the west (Rajmahal Basalt and Intertrappeans) (Mahadevan 2002); that rise to a maximum elevation of 423 m at Tongi Pahar. The region is drained by first and second order streams, originating in the Rajmahal Hills and their outliers. The average rainfall in this area is about 132 cm per annum which falls from July to October. Local vegetation is of the deciduous type and the forest includes both the moist and dry deciduous types (Mahadevan 2002; Ray Chaudhary 1965).

An intensive field survey of the area was conducted, with the aim of sampling different geographic/geomorphic zones (Fig. 1). On location of a site or off site, GPS readings (Garmin Etrex, 10 m accuracy) were taken and a site map was prepared. Within each site; a thorough documentation of various features was made. These included: - a) geographic location; b) stratigraphy and geomorphology; c) raw material sources; d) assemblage structure; e) artefact clustering and spatial distribution across the site; and f) modern disturbance patterns. Although in general, artefacts were collected randomly, grids of 1 x1 m or 2.5 x 2.5 m were laid out at selected areas from within which all artefacts and natural clasts were collected. Further, a collection of all artefacts and natural clasts along with the top 5 cm of sediment cover was made from 1 x 1 m grids at selected sites for the purpose of studying natural formation processes, and to

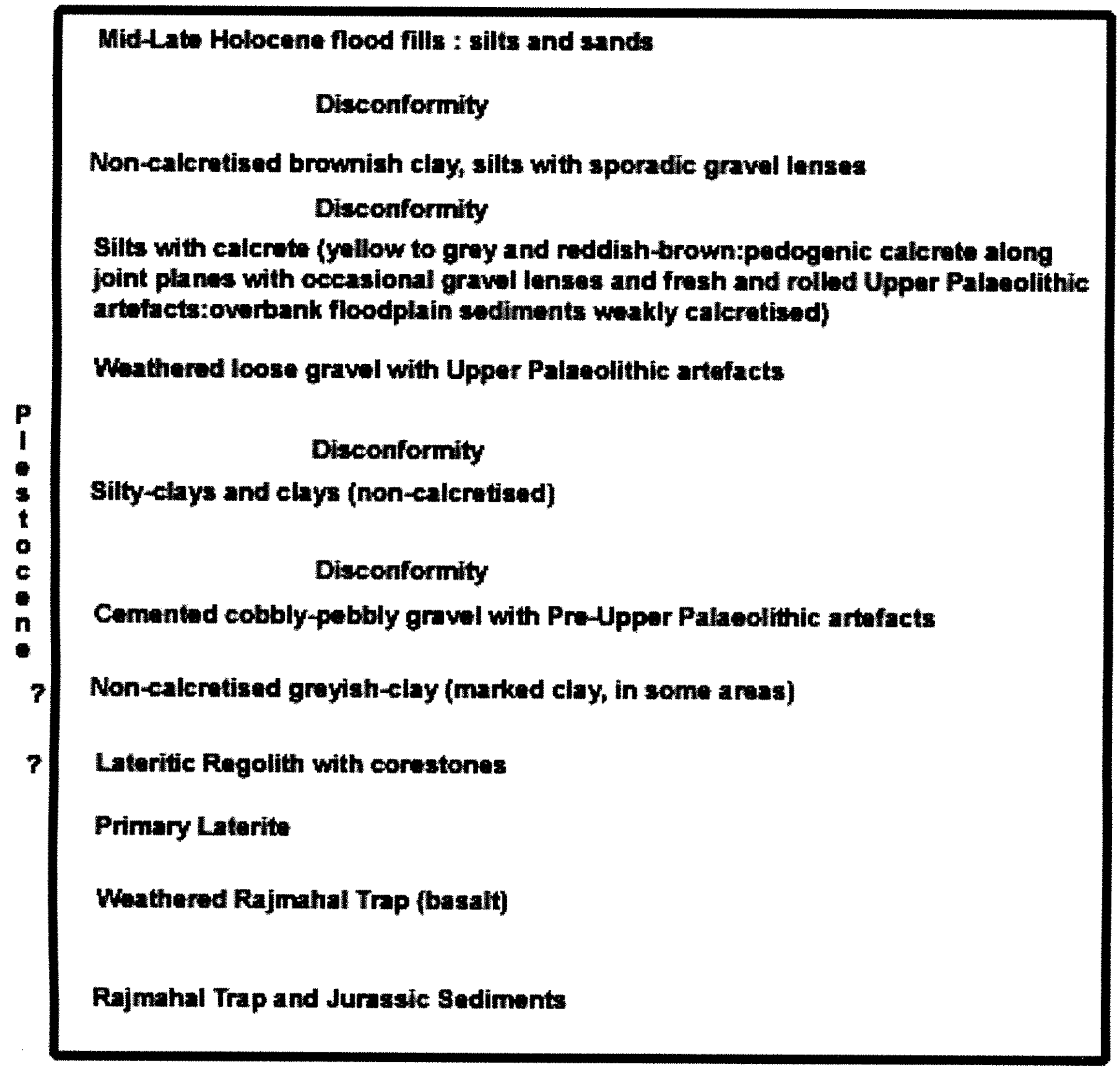
Mid-Late Holocene flood fills : silts and sands
Disconformity
Non-calcretised brownish clay, silts with sporadic gravel lenses
Disconformity
Silts with calcrete (yellow to grey and reddish-brown:pedogenic calcrete along joint planes with occasional gravel lenses and fresh and rolled Upper Palaeolithic artefacts:overbank floodplain sediments weakly calcretised)
Weathered loose gravel with Upper Palaeolithic artefacts
Disconformity
Silty-clays and clays (non-calcretised)
Disconformity
Cemented cobbly-pebbly gravel with Pre-Upper Palaeolithic artefacts
Non-calcretised greyish-clay (marked clay, in some areas)
Lateritic Regolith with corestones
Primary Laterite
Weathered Rajmahal Trap (basalt)
Rajmahal Trap and Jurassic Sediments
Pleistocene
?
?

Fig. 2: Composite stratigraphy of the region

obtain a controlled sample from these sites. At all sites, samples of natural nodules/pebbles/blocks were also collected for studies of raw material usage, and exploitation patterns.

In addition to this, sections were mapped, and sediment and clast samples were collected for further analysis. A sample of chert types from all sources within the region was collected, with the aim of conducting raw material provenance studies. In addition to this, charcoal samples from some sections were sent for radiocarbon dating (Birbal Sahni Institute for Palaeobotany, Lucknow) and samples of sediments for palaeobotanical investigations were sent to the French Institute, Puducherry (Kumar 2005a). The artefact classification system followed methods established by various scholars (Deraniyagala 1993; Ghosh 1993; Inizan *et al.* 1999; Inizan and Lechevallier 1995; Misra 1985; Misra 1989, Murty 1979; Nanda 1984; Paddayya 1970; Raju 1988; Sali 1989; Sankalia 1974; Sharma and Clark 1983), and evolved during the process of analysis.

Prehistoric Localities, Pleistocene Geomorphology and Site Contexts

A total of 17 major localities (ranging from 1-5 km^2) were sampled in detail. Within some localities, several artefact concentrations or sites were noted. In addition to this, exploration between sites yielded scatters of a few artefacts, termed 'off-sites'. Taking into consideration all these, a total of 20 sites and three off-sites were documented, in addition to which sections were studied in detail.

Pleistocene Geomorphology

The oldest landforms in the region are represented by the 300-400 m surface characterised by the Rajmahal Trap Jurassic formations seen in the Rajmahal Hills. Weathered Rajmahal Trap and fossil wood representative of Jurassic sediments were noted at Sonajori, at elevations of 38-43 m AMSL. Weathered Rajmahal Trap is seen all over the region constituting the bedrock. In general, lateritic caps occur on the surface of the Rajmahal Traps, and secondary laterites are also seen (Mahadevan 2002:523). Specific to the study region, we note that overlying the Rajmahal Trap are Tertiary laterites found at elevations ranging from 34 to 92 m AMSL, indicating tilting of the original lateritic plain. Upper Palaeolithic tools are noted on the surface of the lateritic duricrust at several sites and point to the occurrence of a relict landscape. Some of the lateritic regolith may be assigned a relative age by the presence of reworked Upper Palaeolithic tools. The laterites and lateritic regoliths have contributed source material in the form of ironstone, lateritic nodules and granules which have been incorporated into the Pleistocene drainage system of the region.

The significance of the Rajmahal Trap is that it structures the oldest landscape and contributes basalt cobbles; and pebbles made of siliceous material into the drainage. Artefacts are also known in the area around Taljhari, in association with a complex sequence of several generations of regoliths, with artefacts occurring on the surface from 45 m to 84 m AMSL. All artefacts may be assigned to the Upper Palaeolithic phase, thus enabling one to date the latest age of regolith formation.

The weathered Rajmahal Trap is capped by a greyish-black marker clay. Cemented cobbly-pebbly gravel seen only at sections along the river Kirla near Karanghati was significant as it had evidence of in situ pre-Upper Palaeolithic tools, pointing to an older cultural sequence than that seen in the overlying gravels. This is capped by a ferruginised sandy gravel with Upper Palaeolithic tools. This is the first clear indicator of a stratified Lower or Middle Palaeolithic in the region, and is a potential area for further research (Fig. 3)

In sections studied along the river Kirla in and around Karanghati, the sequence reveals a history of flood aggradation during the Late Pleistocene to Holocene, as indicated by the intervening coarse gravel and sand lenses in otherwise clayey-silts. The sections also indicated that the coarse gravel contains a few rolled and fresh Upper Palaeolithic tools. The evidence from sections along the river Kirla, near Chitlo, points to a braided river which flowed 2-3 m above the present channel, and deposited gravel with laterite, Rajmahal Trap, porcellainite and other siliceous nodules. The river built its own terrace. Subsequently a second gravel was deposited, also with artefacts. The river then cut down and deposited alluvium which was calcretised. Gravels forming a strath terrace at Bansjori may also be assigned to the Terminal Pleistocene owing to the presence of Upper Palaeolithic artefacts. The gravel forms a conspicuous channel fill terrace in the area. Upper Palaeolithic artefacts were also noted eroding out of high-level gravels at Jitko (personal communication, S.N. Rajaguru).

Holocene deposits were noted at all sites, in particular in areas around Ilami, Jigri and Amrapara. Post-Upper Palaeolithic stream rejuvenation is also noted. Two radiocarbon dates indicate that deposits along the river Torai at Devpur (53 m AMSL); in reddish/mottled clays overlying Rajmahal Trap and underlying silts; at a depth of 3 m below the surface are dated to 20±90; 1950 AD calibrated age; and the calibrated age range is 1700-1950 AD (BS. No. 2358). At Karanghati (31 m AMSL), charcoal occurs in coarse sands at a depth of 2.15 m below the surface, overlying gravels and underlying silts. This has a date of 3940 ±350, calibrated 3940 BP, calibrated age range 4410-3470 BP (BS. No. 2357). Presence of possible medieval brickbats and potsherds at Ilami helps to date the section. No palaeoecological information from this region

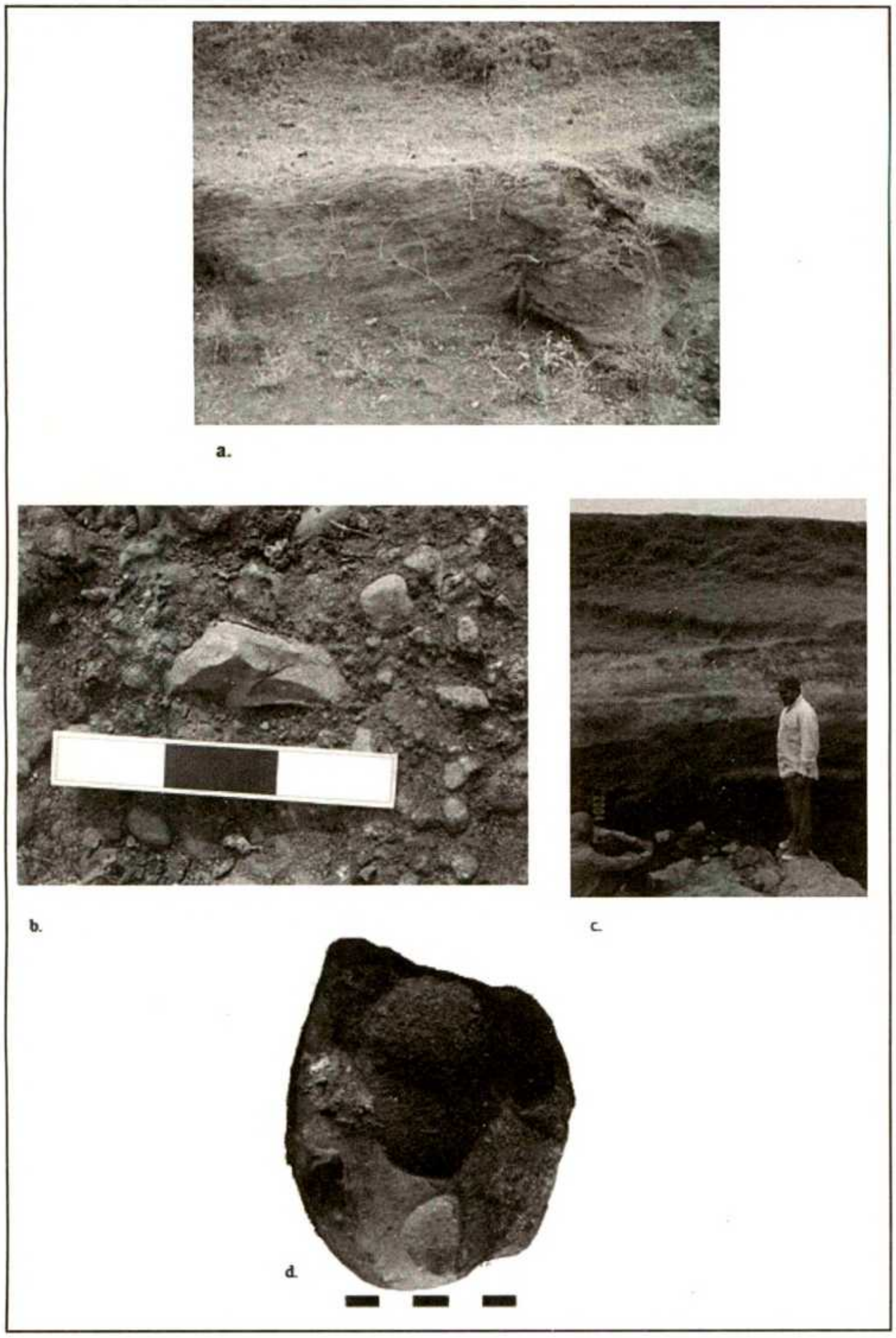

Fig. 3: a. ferruginous gravels with Upper Palaeolithic artefacts overlying cemented gravels; b. embedded artefact in cemented gravels; c. section showing cemented gravels at the base, d. close up of artefact found in this context.

could be obtained, nor have adjacent regions yielded much information on this aspect.

Prehistoric Site Contexts

Upper Palaeolithic sites occur in varied contexts which are summarised in Table 1. As regards surface sites, artefacts are found on the surface of lateritic regolith resting on weathered Rajmahal Trap, or on the surface of eroded

Table 1: Summary of Site Contexts

Context	Locality	Nature of Artefacts
Surface Sites		
a. On the surface of lateritic regolith resting on weathered Rajmahal Trap,	Ramnathpur Hill: 113 m AMSL, Bara Pokhar; 58 m AMSL; Ranga, Parerkola	Upper Palaeolithic
b. On the surface of the eroded lateritic duricrust	Ghagorjani;	Upper Palaeolithic
c. Regoliths-four phases of lateritic regolith.	45-54 m AMSL	
Regolith 1: pediment bench comprising a core-stone basalt artefacts regolith affected by latosolic weathering, and containing few lateritic pellets. Extensively subjected to soil stripping and erosion.	Taljhari-3:Regolith-1: pediment bench 84 m AMSL	Upper Palaeolithic
Regolith 2:comprising weathered basalt, latosol, fewer iron nodules, and pisoliths as compared to Regolith-1, and chalcedony nodules	Taljhari-1: Regolith-2:62 m AMSL	
Regolith 3: comprising a reddish latosolic soil sediment rich in laterite pellets and nodules, and derived from older lateritic regolithis; rests directly on the Rajmahal Trap, absence of calcrete nodules; locally derived siliceous nodules, high percentage of lateritic nodules: possibly constituting part of the pediment retreat and an erosional landscape.	Taljhari upland; Regolith-3:52 m AMSL (Taljhari-3 is between Regoliths 1 and 2)	
Regolith 4: marked by a distinct calcrete lag, indicative of some relative aridity.	Kariodih: Regolith 4:45 m AMSL	
d. On the surface of weathered Rajmahal Trap	Rurgo, 97 m AMSL, localities at Parerkola, Binjha Mahal, between Kariodih and Ranga, between Nipania and Kumarbag, Gamaria	Upper Palaeolithic
e. Along hill slopes eroding out of lateritic regolith	Dohari Pahar	Upper Palaeolithic
f. Surajbera rock shelter	On surface of red soils	A few flakes
Fluvial Gravels		
a. Coarse gravels capped by brown clays and overlying grayish-clay deposits, around 4.95 m; 20 cm thick; above the channel bed-alluvial fill deposit suggestive of aridity	Section 2, River Kirla, north bank; elevation 35 m AMSL on channel bed	A few rolled and fresh Upper Palaeolithic artefacts
b. Ferruginised sandy gravel; 1 m thick; overlying cemented cobbly-pebbly gravel with pre-Upper Palaeolithic tools	Section 4, River Kirla, north bank; 32 m AMSL	Upper Palaeolithic artefacts eroding out of and the gravel; and also resting on the surface of the underlying cemented gravels.
c. cobbly-pebbly high-level gravels, rich in lateritic pellets, comprising ironstone, lateritic nodules, siliciceous nodules, subrounded, clast supported no calcrete, weathered basalt pebbles.	Chitlo, section 2: on river Torai; left bank; 52 m AMSL Chitlo site, 56 m AMSL	Upper Palaeolithic artefacts
d. High level strath terrace gravels forming a lag developed within a pediment bench and capped by brownish silts.	Bansjori , section 1: 73 m AMSL and Locality 1	Upper Palaeolithic

e. High level granular pebbly-sandy gravel	Jitko 76 m, Locality 1 Locality 2: on left bank of the stream:	Upper Palaeolithic tools in gravel and in silt.
Silts and Clays		
a. Silty-clays with calcrete: grayish to reddish-brown silty clays with blocky pedal development and rich in calcrete nodule	Chitlo: Section 1: on river Torai; 59 m AMSL	Upper Palaeolithic
b. Greyish-brown silty clay, 10 cm thick, rich in calcrete. This rests on a regolith rich in basalt core stones and latosolic weathering. It underlies, a non-calcretised brownish silt.	Jhenagaria; 54 m AMSL	Upper Palaeolithic artefacts occur on the surface eroding out of the of the silty-clay and in association with calcrete nodules
c. Non-calcretised brownish silt	Jhenagarai: Locality 3, Saolapur	Upper Palaeolithic artefacts on the surface without any indication of calcrete

Table 2: Results of study of clasts and artefacts from sieved sediments

Site				**Size Range (mm)**							
	40-80	**20-40**	**10-20**	**8-10**	**4-8**	**2-4**	**1-2**	**<1**	**Remainder**	**Weight (g)**	**Total Weight (g)**
Jitko:clasts			895	600	105	90	100	55	50	1895	2370
Jitko:artefacts		105	255	65	45	5				475	
Chitlo village-1:clasts		350	145	185	50	65	155	70	80	1100	1530
Chitlo village-1:artefacts		345	70	10	3	2				430	
Chitlo village:clasts	280	355	350	490	270	105	195	110	120	2275	3215
Chitlo-village:artefacts	205	255	250	200	25	5				940	
Jhenagaria-1a:clasts		170	70	245	105	25	95	70	45	825	1863
Jhenagaria-1a:artefacts	260	420	295	50	10	3				1038	
Jhenagaria-2:clasts	345	265	155	270	100	10	10	5	2	1162	1621
Jhenagaria-2:artefacts		265	90	95	5	4				459	
Jhenagaria-1:clasts		1590	250	200	50	20	50	79	7	2246	2313
Jhenagaria-1:artefacts		60		5	2					67	
Ranga:clast	650	565	100	55	5	5	3	2	2	1387	2847
Ranga:artefacts	640	745	55	20						1460	

lateritic duricrust. Artefacts are also noted on a series of regolith surfaces in the Taljhari complex. As there is no variation in tool types or technology in these surfaces, it is inferred that there was no major difference in time span between the four regolith surfaces and it is possible that regolith formation occurred solely during the Terminal Pleistocene. A geological test pit at Kariodih (45 m AMSL) yielded a gravel (10 cm thick) rich in quartz, chalcedony, ironstone and basalt, resting on the weathered Rajmahal Trap. Artefacts occur only on the surface of this gravel and occasionally in association with a calcrete lag. Artefacts are also seen along hill slopes eroding out of a laterite regolith. A few flakes were noted near the Surajbera caves on the surface, resting on red soils.

Sites also occur within fluvial gravels, such as those eroding out of coarse gravels capped by brown clays and overlying greyish-clay deposits, as seen along the river Kirla. Along the same river, artefacts were noted within a 1 m thick ferruginised sandy gravel, overlying a cemented cobbly-pebbly gravel with pre-Upper Palaeolithic tools (Fig.3). They are also noted within cobbly-pebbly high-level gravels, rich in lateritic pellets, comprising ironstone, lateritic nodules, siliceous nodules, and which are subrounded, and clast supported, lacking calcrete and with weathered basalt pebbles. They also occur within calcretised silty-clays inset against this deposit at elevations of 52-56 m AMSL. Assemblages were noted within high-level strath terrace gravels developed within a

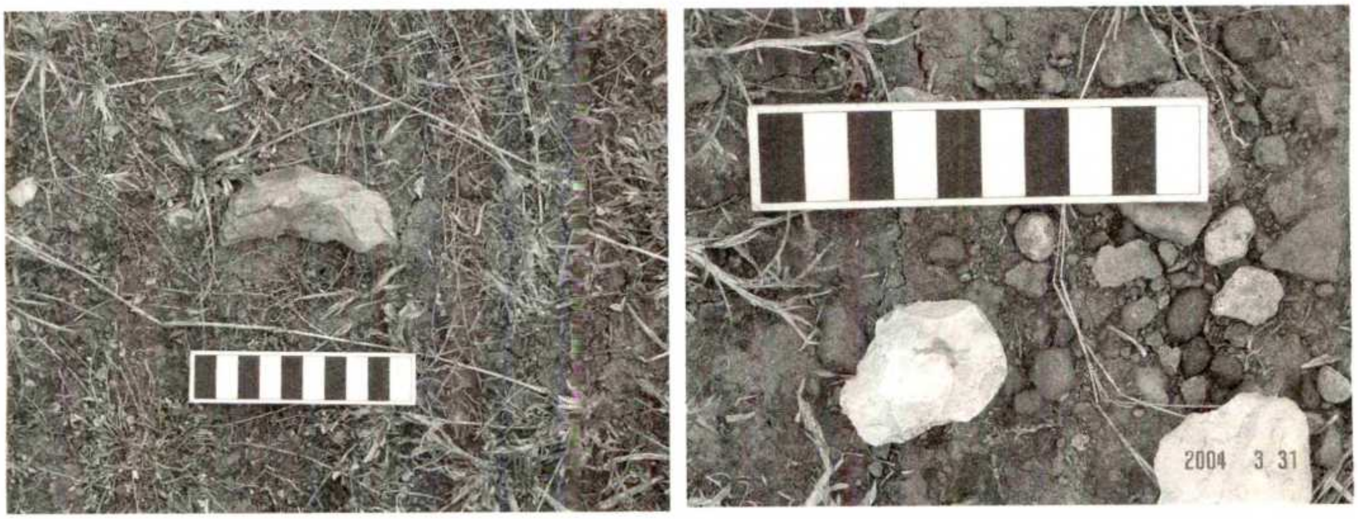

Fig. 4: Close up of artefacts at Chitlo on high level gravels

pediment bench and capped by brownish silts at 73 m AMSL, and within high-level granular pebbly-sandy gravels +2 to +3 m above channel beds along the Kirla river. Upper Palaeolithic assemblages are also noted within grayish to reddish-brown silty clays with blocky pedal development and rich in calcrete nodules, which in some sites rest on a regolith rich in basalt core stones and latosolic weathering, and in non-calcretised brownish silt (Fig. 4).

To understand the effect of fluvial processes on the composition of the assemblage structure, a 1 x 1 m grid was laid out at selected sites, the top 5 cm of sediment was recovered in full. This sediment was then passed through sieves and the weight of all artefacts and natural clasts at various size range intervals was measured. Results show variability in the weight of microdebitage versus natural chips at different sites (Kumar 2005a: 243). As seen in Table 2, this data indicates that a high percentage of microdebitage generally falling within 4-10 mm are noted at most sites, both resting on bedrock or those on high level gravels, pointing to minimal fluvial disturbance.

Lithic Assemblages

Pre-'Upper Palaeolithic' Artefacts

Four Lower or Middle Palaeolithic artefacts were found at the base of a 1.5 m thick cobbly-pebbly gravel in the river Kirla near the village of Karanghati. They occur below a sandy gravel with Upper Palaeolithic artefacts. Four more tools were recovered from the river bed around 200 m downstream of the same section. All artefacts are rounded and intensively patinated and types found are described in Table 4. They comprise large rolled chopping tools, tabular trimmed chert blocks, knife, and flakes and differ typologically and technology, and in terms of rounding/ abrasion from the overlying assemblages (Fig. 3).

Upper Palaeolithic Assemblages

A total of 1494 artefacts were analysed, and described below.

Artefact State and Physical Condition

Most artefacts are complete (n=1447; 96.85 %) with 47 (3.15%) being broken. The majority are moderately to intensely patinated (n=891; 59.64%), with 567 (37.95%) being unpatinated, and 12 (0.80%) having only mild patination. Fifteen scrapers and three irregular utilised pieces (n=18; 1.20%) had evidence of two stages of patination and in the remaining (n=6; 0.40%) patination was unclear. The maximum number of artefacts are unabraded (n=1156; 77.38 %), 61 (4.09 %) are intensively abraded or rounded; while 277 (18.54%) are only mildly abraded or rounded.

Raw material

The principal raw material utilised comprises siliceous rocks of which chert predominates (Table 3). Chert occurs as outcrops within the Rajmahal Traps at Parerkola, Gamharia, Sonajori, Jhenagaria and Chitlo, and are exposed owing to weathering of the Traps. At Gamharia the outcrop could not be located, but was presumed to be

Table 3: Raw material types

Raw Material	%
Chert	81.06
Chalcedony	15.06
Agate	2.48
Quartz	0.60
Basalt	0.40
Fossil wood	0.07
Others	0.33

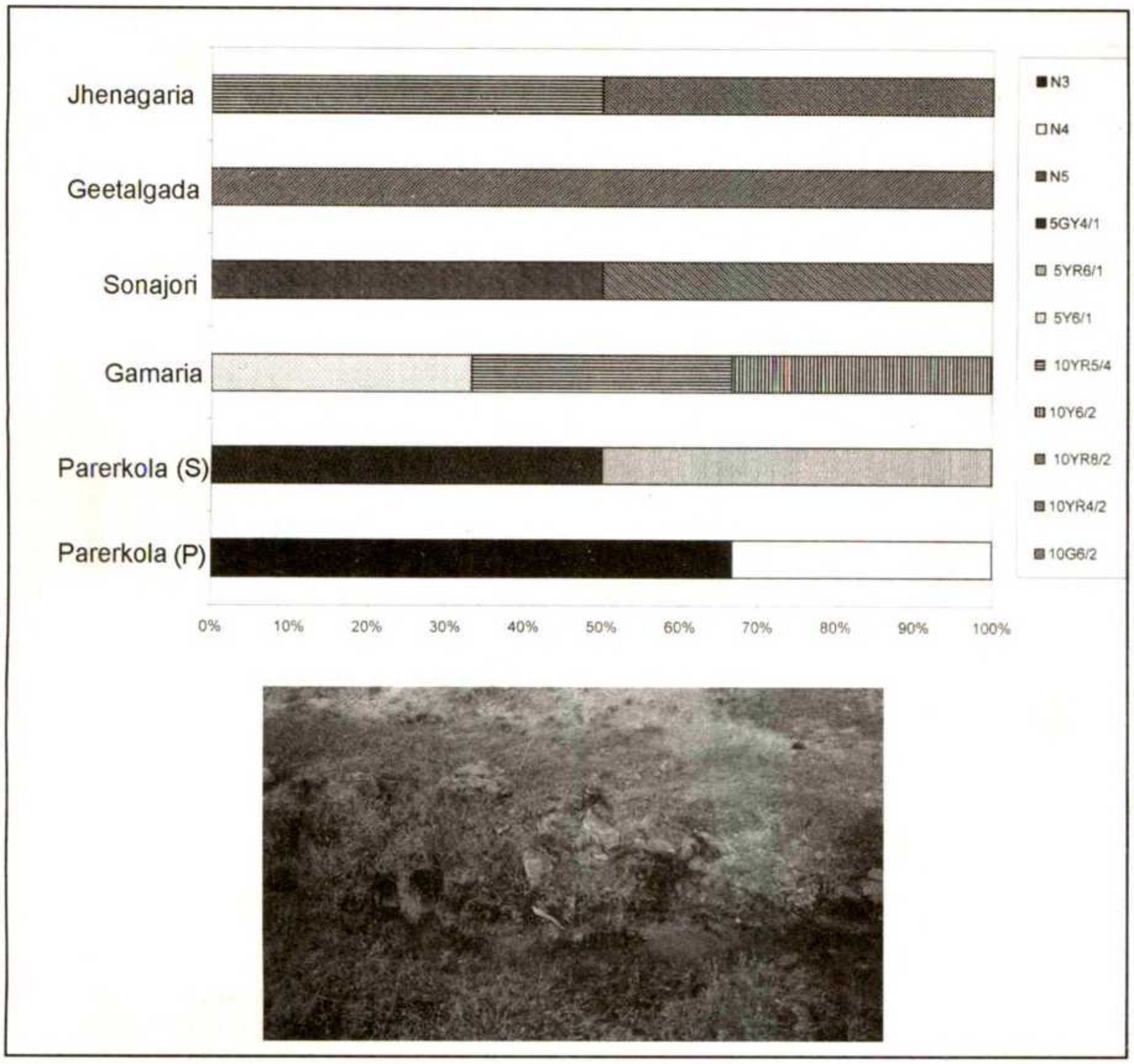

Fig. 5: Major outcrops of chert and graph showing chert types (colour based on Munsell Rock Colour Chart)

in the vicinity, owing to the presence of large chert nodules around 30 cm in length at the site. Brownish chert predominates, although a variety of colours are noted (Fig. 5). Only one tool on fossil wood was obtained at Chitlo village. The only source of fossil wood is at Sonajori and occurs within the Rajmahal Trap. A few artefacts are on other siliceous materials, with a small percentage on basalt.

Cores

Cores form only a small percentage (7%) of the total assemblage, and do not predominate at any site. A total of 110 cores were found which include blade cores (n=64), flake cores (n=21) and intensively reduced blade or flake cores (n=25) (Table 4). A higher percentage of cores are noted in the Taljhari and Chitlo complexes and at Kariodih, all of which are within a radius of around 2 km from the Jhenagari and Chitlo chert outcrops. Cores are smaller in size than locally available nodules, and no cores suitable for the detachment of blades >40 mm are noted (Kumar 2005b).

Blade cores (n=64) have mean dimensions of 40.29 x 31.52 x 22.73 mm While the majority are on chert; there is one example each on basalt, agate, chalcedony and quartz (Fig.6). Blade cores include opposed platform cores (n=10) and multiple platform cores (n=8). Single platform blade cores (n=25) constitute the bulk of the sample and comprise various types. These include standardised pyramidal to rectangular cores (n=9), which range in shape from typical fluted cores to those which are roughly pyramidal and rectangular (Fig. 6). Amorphous cores (n=16) are globular, plano-convex or amorphous in shape

Table 4: Artefact types and dimensions (n=1494)

Artefact Type	**Count**	**% of Total Artefacts**	**Dimensions (mm) (L x B x T)**
PRE-UPPER PALAEOLITHIC ARTEFACTS	8		
(River Kirla near Karanghati)			
Chopping tool	1	12.5	100.68x80.53 x 48.89
Flakes	4	50	79.85x65.52x22.85
Modified tabular chert block	2	25	116.51x72.98x47.75
Knife	1	12.5	93.79 x 51.05 x 27.43
UPPER PALAEOLITHIC ARTEFACTS			
CORES			
Blade Core	**64**	4.28	40.29x31.52x22.73
oppossed platform	10	0.67	37.87x31.69x23.06
multiple platform	8	0.54	39.48x31.81x24.15
standardised pyramindal to rectangular	9	0.60	52.36x39.12x29.00
amorphous	16	1.07	40.25x35.67x26.73
intensively reduced	7	0.47	36.03x19.27x13.87
microblade	14	0.94	28.91x23.62x14.01
Flake Core	**21**	1.41	64.63x50.83x34.03
Blade/flake core (exhuasted)	**25**	1.67	36.36x28.11x20.67
FINISHED TOOLS			
SCRAPERS			
convex	41	2.74	48.31x38.88x15.90
hollow	3	0.20	40.99x27.91x12.85
convergent	11	0.74	49.20x45.25x15.68
singe straight sided	55	3.68	38.67x24.89x12.18
single straight and end	21	1.41	40.14x23.57x10.87
double straight sided	2	0.13	29.58x24.93x10.65
double straight sided and end	29	1.94	43.95x29.01x11.68
round	9	0.60	38.73x41.28x11.88
thick	3	0.20	47.87x35.98x20.21
nosed	11	0.74	50.98x35.77x24.99
thumbnail	28	1.87	24.47x22.64x9.16
end scraper	2	0.13	43.72x47.90x13.05
core scrapers	15	1.00	59.15x49.74x31.61
Points	8	0.54	30.71x26.52x9.69
Borers	43	2.88	38.49x29.86x12.65
Burins	18	1.20	30.91x22.02x10.74
Denticulates	13	0.87	53.94x37.14x11.36
Knives	6	0.40	82.18x61.01x22.01
Macrolunate	1	0.07	81.89x34.31x27.03
Notch	4	0.27	39.12x39.21x9.29
Irregularly retouched pieces	63	4.22	43.43x33.84x14.64
Microlithic component			18.49x18.36x5.98
blades	5	0.33	
non-geometric microliths	4	0.27	
triangle	1	0.07	
crescent	2	0.13	
pen knife	1	0.07	

Artefact Type	Count	% of Total Artefacts	Dimensions (mm)
DEBITAGE			
chips	300	20.08	14.23x10.99x4.75
chunks	283	18.94	33.55x22.71x13.45
flakes	256	17.14	28.53x22.10x9.46
blade core debitage	70	4.69	
core tablets	4	0.27	55.71x41.64x21.98
blade core trimming flakes	46	3.08	34.98x29.56x13.05
outrepasse flakes	2	0.13	33.25x16.45x14.04
microblade core trimming elements	9	0.60	22.08x15.24x9.88
crested guided ridge flakes	9	0.60	39.16x15.75x12.77
Utilized unretouched blades	12	0.80	33.87x24.51x10.04
Broken artefacts	47	3.15	
GRAND TOTAL	**1494**		

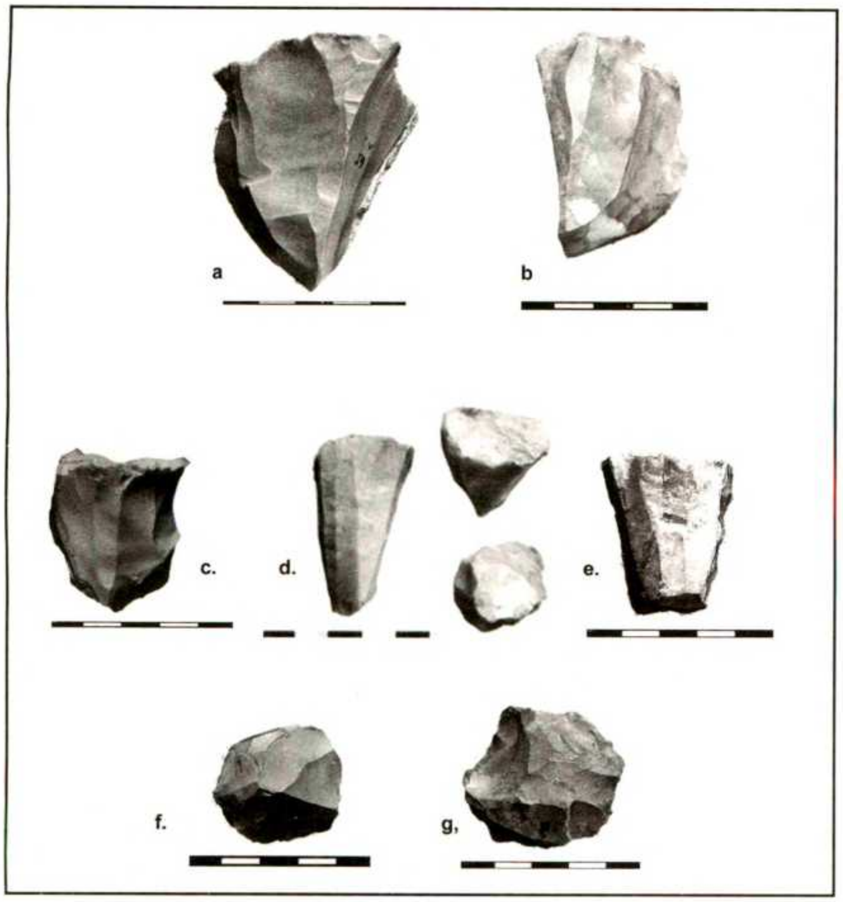

Fig. 6: Blade cores (a, b, c, d, e) and flake cores (f, g)

and appear to be heavily reduced (Table 4). A total of seven cores appear to be intensively reduced blade cores (n=7) and are generally rectangular in shape. It is unclear as to whether these represent reduced nodules or broken or core trimming elements. A total of fourteen cores were used for the production of microblades, which are <20 mm in length. It is difficult to determine whether they were solely utilised for the production of microblades (mean dimensions of microblade scars is 18.31 x 5.16 mm). Larger blades were also detached from the core. These cores have mean dimensions of 28.91 x 23.62 x 14.03 mm. Microblades have been struck from a single platform. In one case the core has been retouched to form a borer-like pointed tool. A unique variant is a single platform core on a thick flake.

There are 21 flake cores in the assemblage, with mean dimensions of 64.63 x 50.83 x 34.03 mm (Table 4). These include four Levallois flake cores, one of which is on a thick flake, and two discoidal cores. Amorphous flake cores include globular cores (n=11), tabular flake cores on nodules or split nodules (n=3) and an elongated core on a nodule. There are 25 intensively reduced blade and/or flake core remnants. In 16 cases <25% cortex covers the surface. It is difficult to estimate the number of blades or flakes detached as also the nature of striking platforms (Table 4).

Finished Tools

There are 399 finished tools of which scrapers of different types predominate (Fig. 7, Table 4). Scrapers occur on a wide range of blank types including flakes, blades, blade core rejuvenation flakes and nodules. Retouch is largely irregular, with some examples of scalar or nibbling retouch. In addition to scrapers, 18 burins were noted on flakes, nodules, blades, and chunks. Both single and double burins are noted on elongated nodules. A total of 43 borers on flakes, nodules, blades, blade core trimming flakes and cores were noted. A large number of irregularly retouched pieces (n=63) were also found, of which 24 are on side- or end struck flakes. Twenty-one tools are on nodules, ten tools are on unclear blanks and one is on blade core trimming flake. Denticulates are thirteen in number. Only eight points were seen all of which are on flakes. A small number of knives and notches were noted. The thirteen microliths include backed blades, non-geometric flake tools, crescents, a triangle, and a penknife, with mean dimensions of 18.49 x 18.36 x 5.98 mm. Blades (whether unretouched or retouched into different tools) are very few in number and are discussed later.

Debitage

A total of 985 debitage pieces were studied (Fig. 8, Table 4). These include blade core trimming elements. These comprise blade core rejuvenation flakes, outrepasse flakes, microblade core trimming elements, etc. Broken blades, and other broken tools, chips and chunks were also found.

Discussion

In the absence of chronometric dates, high spatial resolution and biological remains, prehistoric behaviour in the region can be inferred primarily from assemblage structure and lithic technology. One must also consider factors including reuse of sites exposed through erosion over long time periods.

An intensive survey of the region yielded 20 sites and three off sites. Lowlying areas currently buried under thick deposits of Holocene alluvium, or extensively disturbed by cultivation/construction did not yield any artefacts. Site sizes range from a few tools/m^2 in off-sites such as areas covered by Kariodih and Ranga and between Nipania and Kumarbag, to clusters of >10/m^2 in the Chitlo, Kariodih and Taljhari site complexes. In general artefacts occur as scatters across the landscape. Fluvial action on artefacts has been minimal at most sites, as noted earlier. This is also seen in the presence of blocks or nodules of chert, which are not rounded and are very fresh. As discussed earlier, most artefacts are also unabraded. Artefacts exhibit a variation in patination and weathering. Most are unabraded, while patination varies. Weathering and patination in chert, is a complex process dependent greatly on the nature of the chert and on soil conditions (Luedtke 1992). The brownish patina seen in most cases is very common in cherts (Luedtke 1992:100), and may be a function of the presence of iron in groundwater. As the region has a high percentage of iron derived from weathering of Tertiary laterites and their redeposition over the landscape; this is one possibility which must be examined in detail in future studies. The presence of artefacts with double patination may indicate reuse of tools/cores/debitage at a later period, although patination rates may be fairly rapid and thus this hypothesis must be verified in future studies.

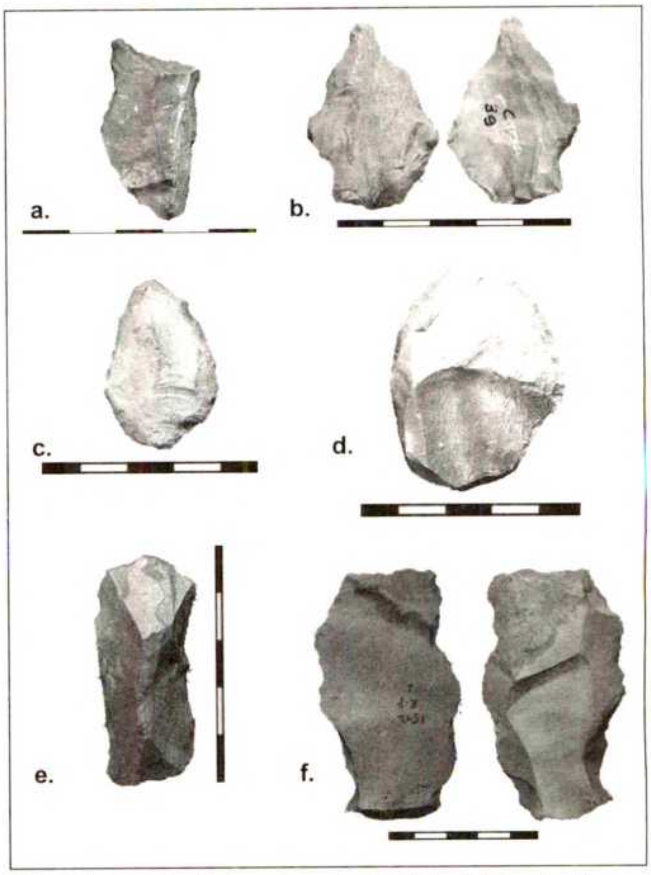

Fig. 7: borers (a, b), scrapers (c, d), flake-blades (e, f)

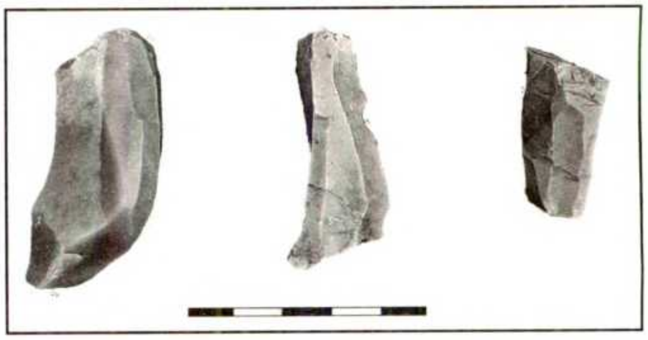

Fig. 8: Debitage: blade core trimming debitage including reduced blade cores.

Siliceous raw materials were predominantly used. Chert occurs as outcrops within the Rajmahal Traps, which are exposed at several sites. Cherts, which are weathered from outcrops, do not generally move very far from their source (Luedtke 1992:102). However, over most of the study region, chert occurs in the form of small nodules. It is possible that these represent; a) nodules distributed through fluvial processes; or b) weathered previously from outcrops which are not visible today. The latter possibility is considered more relevant, as the chert nodules are neither rolled nor do they display any other evidence for fluvial transport, except when noted in stream channel beds. Brownish chert predominates. Only one tool on fossil wood was noted at Chitlo village. The only source of fossil wood is at Sonajori where they occur within the Rajmahal Trap. The mean dimensions of nodules are 30.07 x 20.96 x 12.99 mm (ranging from 6.99-125.42 mm, sd=15.42). Most fall between 10-40 mm in size (78.60%), with a smaller percentage occurring between 40-60 mm (15.28%). In general, raw material nodules from Ranga, Rurgo Pahar, Saolapur, Kirla Nadi and Dohri Pahar are larger in size than those at other sites. However, chert blocks eroding out of the Rajmahal Trap can measure upto an average of 30-50 cm and were very probably exploited, although evidence of preliminary trimming of these is yet to be noted. Core sizes roughly correspond with, or are larger than, the size range of nodules available, although no cores suitable for detachment of flakes or blades >40 mm are seen. Variability in types of raw material between sites is minimal, and no correlation between raw material types and tool types is seen.

The sample of cores (n=110; 7 %) available for study indicates that the principle strategy was blade production (Kumar 2005a). This is noted in the high percentage of blade cores of various kinds (n=64; 58.18% of the total cores and 4.28% of the total assemblage), including cores for the production of microblades (n=14; 12.73% of the total cores and 0.94% of the total assemblage). Further, the presence of both opposed platform and multiple platform cores points to intense utilization. Both standardised fluted cores and amorphous cores are seen. A small number of core trimming flakes bearing microblade scars (n=13), point to the presence of microblade cores as well, although in some cases it is not clear as to whether, in some cases, larger flakes were being utilised to detach microblades. If this is so, then both nodules and larger flakes were utilised for blade production. Microblade scars are noted on a few cores which were also used to detach larger flakes/blades. Further, such cores and blades occur within the same stratigraphic context as the other artefacts. Cores for the production of blades of all sizes are noted in the same stratigraphic context at all sites. The distinction between blades, bladelets and microblades (Inizan *et al.* 1999:73) is often variable, and based on guidelines which are often site or region specific. The available sample size is very small and from surface collections. Thus quantifying variability in core types for detachment of larger, medium or smaller blades, bladelets and microblades is often not very clear. It must be remembered that types may often grade into each other depending on the stage in the reduction sequence represented. Thus, at this stage of research, it is preferred to regard these as constituting an integral part of the industry and blade core technology of the region. It is thus believed that microlithic blade cores form an intrinsic part of the Upper Palaeolithic of the region and do not represent a separate 'Mesolithic' or later cultural phase. Flake cores are however minimal in the assemblage (Table 4) (n=21; 1.41% of the total assemblage and 23.1% of the total cores) and include both a small percentage of Levallois cores and amorphous flake cores. Cores are noted at all sites, although in small percentages. Little variability in core types is seen across the region, even at sites closer to raw material outcrops (Fig. 9).

However, despite this fact, the industry is basically based on flakes with only a small percentage of artefacts on blades. A high degree of mobility may be inferred from the extensive movement of blades and tools on blades across the landscape. Thus, though blade cores are present in the assemblage, there are very few blades (n=12; 0.80 %) or tools on blades (n=28; 1.87%). It is thus likely that the blades were transported and used elsewhere, and may be searched for in areas falling outside the study region. Amongst the 41 blades noted in the collection only 28 are retouched into tools. Blades range in length from 17.42 mm to 89.27 mm. However, few blades correspond with blade scar sizes on cores. There is a paucity of standardised blades as seen in the assemblage which may have come from the fluted or standardised blade cores. Blade cores for the detachment of large blades (with scars measuring around 37 mm) are only three in number, despite the presence of such blades in the assemblage. Although Levallois blades are noted, only one Levallois core for the detachment of a pointed blade-like flake was noted. Tools on blades have mean dimensions of 46.76 x 25.11 x 11.08 mm and range from a minimum of 24.28 mm to a maximum of 89.27 mm in length. Eight tools have cortex with cortex percentage being less than 25%, while one had 25-50%. Despite the presence of cores for detachment of microlithic blades and bladelets, only two microblades were noted of which one was retouched (backed).

Similarly, the abundance of tools on flakes (n=241; 16.13%); is disproportionate as compared with the number of flake cores (n=21; 1.41%). The paucity of flake cores in this assemblage may be interpreted in two ways; a) the preliminary trimming of flake cores was done elsewhere, followed by transport of flakes to the camp sites; and b) the detachment of flakes was a part of the general blade manufacturing strategy as a result of which cores were being totally exploited for both flakes and blades, and thus were heavily reduced. The second hypothesis appears to be more plausible when examining evidence in other parts of the world (Davidson and Goring-Morris 2003).

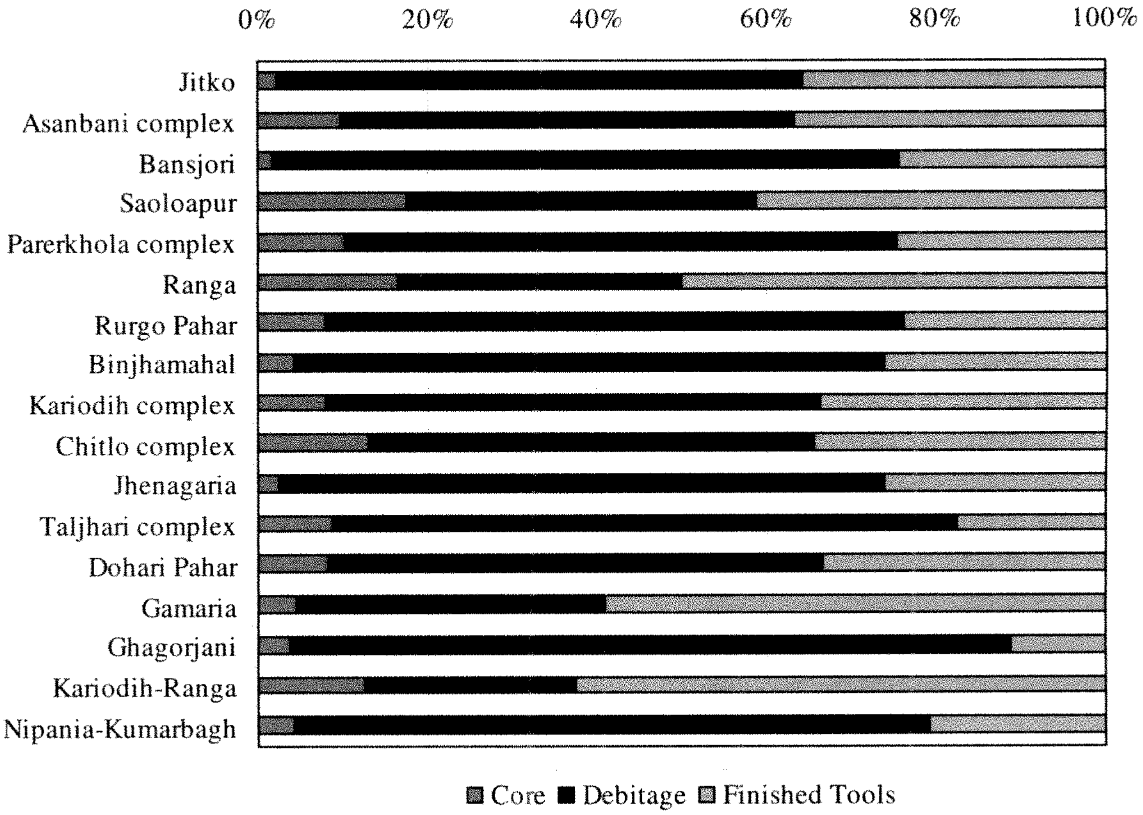

Fig. 9: Intersite variability in cores, debitage and finished tools

Debitage constitutes most of the assemblage, exceeding the number of finished tools at almost all sites (n=985, 66%). At Bansjori, Kariodih complex, Rurgo Pahar, Parerkola and Taljhari complex, debitage exceeds the percentage of finished tools by more than half. At other sites the variation in percentage of debitage and finished tools is not much. Debitage is largely noncortical, possibly representative of later stages in the reduction sequence. The presence of debitage indicative of core trimming and rejuvenation, such as outrepasse flakes, core tablets and core rejuvenation flakes and other core and microblade-core trimming elements points to some degree of rejuvenation of blade cores. Cortex when present, is generally <25% (n=169; 17.16% of the total debitage). Cortex exceeding 50% or covering most of the debitage surface is seen only in 49 cases (4.97% of total debitage) and is >50% in only 18 cases (1.83%), most of which were concentrated in Kariodih and Taljhari site complexes. The majority of the finished tools are noncortical. At sites closer to outcrops of raw material, there does not appear to be any greater evidence of preliminary trimming of chert blocks, or higher percentage of cores or primary stages of debitage. This evidence appears to point to some degree of tool manufacture and core reduction occurring at most sites over the region.

A wide range of artefact types were noted, predominantly scrapers of various types as also denticulated tools, borers, burins, core scrapers, and points, with little intersite variability (Table 4), Retouch is in general irregular, and a number of flakes and blades appear to have been utilised without retouching. An important aspect of the industry is the possible reuse of artefacts as indicated by differential patination, (keeping in mind that rates of patination in the region are as yet unknown, and reuse may have been only after a short time span). Interestingly, nodules were used for tool manufacture at almost all sites.

Taking into consideration, areas adjoining the Damin region, we find interesting observations from the Rajmahal Hill industries, located barely 40 km west of the study region, and studied by Pratap (2000). Termed Neolithic, owing to the presence of a few ground stone axes/adzes, these assemblages however shows a similarity with the Damin industries in terms of assemblage structure, tool dimensions and lithic technology. The Rajmahal Hill region has a low blade core:blade ratio (1:5.8) and evidence of transport of nodules. This is the opposite of what is noted in the Damin area where cores exceed blades by a ratio of 1.6:1 with local raw material availability. It may be hypothesized that prehistoric population movements occurred over both the Damin and Rajmahal areas, creating the patterning seen today. It is possible that some of Pratap's collections may represent an Upper Palaeolithic phase.

Situating the Damin industries within the context of the Eastern Indian Palaeolithic is a complex task, and relies largely on defining what is meant by the 'Upper Palaeolithic' in the region and whether this terminology requires rethinking (James and Petraglia 2005; Mishra 1995). In Eastern India, in some cases, distinguishing between Upper and Middle Palaeolithic industries is not very clear, despite differences in terms of raw materials used, lithic technology and assemblage structure. Continuity in lithic types is present as seen from Middle Palaeolithic assemblages in Ranchi, Bhimband, and Jamalpur, (Narayan 1996; Pant and Jayaswal; 1977-78, Kumar 2005a). This is also seen in the complex nature of the Damin industries. The Damin region has yielded evidence of pre-Upper Palaeolithic tools in the form of large chopper-chopping tools and thick flakes on chert, from within a cemented gravel underlying gravels bearing blade-based industries. It is not as yet clear whether these constitute a part of the Lower or Middle Palaeolithic.

In Eastern India, the presence of what has been termed Upper Palaeolithic, Epi-Palaeolithic and microlithic, still remains sparsely known in terms of stratigraphic context or lithic technology (Basak 1997; Bhattacharya 1991; Bhattacharya and Singh 1997; Chakrabarti 1986; Chakrabarti 1993; S. Chakrabarti 1998-99; S. Chakrabarti *et al.* 1982; Chakrabarti and Bhattacharya 2001; Datta 1991a, 1991b, 2000; Ghosh 1970; Lal 1958; Nanda 1984, 1985, 2000; Narayan 1991-92, 1996; Paddayya 1970; Pal 1981; Pant and Jayaswal 1977-78; Ray 1985; Tripathy 1986-87).

Despite these problems, the Upper Palaeolithic of Eastern India appears to have distinct regional variability, with a marked difference between the Singhbum flake-blade industries with those noted in other districts. As regards assemblage composition in the Damin industry, the predominance of scrapers can be compared to those seen in Singhbhum, and from the Hazaribagh-Giridih area (Chakrabarti and Chattopadhyay 1987). At other sites classified as Upper Palaeolithic in Eastern India, there is a predominance of tools on blades or unretouched blades, unlike the situation in the Damin complex. The size range of blades in the Damin industry (17.42 mm to 89.27 mm), may be compared to that of other sites in the region which show a wide range of variation in size ranges amongst industries termed Upper Palaeolithic (Chakrabarti 1993; Pant 1982; Kenoyer *et al.* 1983; Sharma *et al.* 1980 Sharma and Clark 1983; Pal 1981; Narayan 1996) Industries termed Epi-Palaeolithic (Bhattacharya and Singh 1997:31-32; 1998) show some similarities with the Damin area in the size ranges of cores and blades, with differences in the paucity of blades or tools on blades in comparison to the number and nature of cores present in the industry. In industries in the Indravati Valley in Orissa (Nanda 1984, 1985); artefacts on flakes predominate, just as they do in the Damin area. The occurrence of microliths at a large number of Upper Palaeolithic sites as documented by Chakrabarti and other scholars is significant (Chakrabarti 1993; Narayan 1996). The derivation of both blades and flakes in the core reduction sequence; and the presence of microblade cores as part of this strategy have also been documented in the Indravati valley (Nanda 2000). In Bihar and Jharkhand, these industries are largely non-geometric, with tools ranging in size from 1.5-2.5 cm or up to 4 cm (S.R. Roy mentioned in Narayan 1996:295-296). In West Bengal, microliths are found along with Upper Palaeolithic assemblages at several sites (M. Bhattacharya 1991:33). In the Damin region, too, the microlithic element appears to be an intrinsic part of the Upper Palaeolithic. However, the percentage of tools either in the form of microblades or microlithic retouched tools is minimal, and this often depends on what the scholar studying the assemblage characterizes as what constitutes 'microlithic' and in variations in the frequency of microliths on blades or flakes (Kumar 2005a; Ghosh 1970; Chakrabarti 1993; Datta 1991a, 1991b, 2000; S. Chakrabarti 1998-99; Chakrabarti 1993).

Problems in what characterises the 'Upper Palaeolithic' in India, issues related to terminology, chronology, regional variability, its microlithic component, evolution and change, have been addressed by scholars through the years (James and Petraglia 2005; Murty 1979; Paddayya 1970; Misra 1989, Mishra 1995). In this context, the Damin complex thus constitutes a unique and interesting facies in the Upper Palaeolithic of Eastern India. With the present data, it is perhaps not meaningful to either change the terminology, or speculate on their chronological position within the broader Late Pleistocene industries in India. Instead, is perhaps better to treat the combination of characteristics (presence of standardized fluted or prismatic blade cores, high percentage of scrapers and flake tools, paucity of blades and microblades) in terms of prehistoric mobility strategies and region specific land use patterns in the Terminal Pleistocene. This re-examination of key assemblages in Jharkhand has resulted in a better understanding of site contexts and assemblage variability. The blade and flake core reduction strategies were studied, and attempts were made to understand patterning seen in terms of the movement across the landscape. Excavations at key sites to obtain better stratigraphic and chronological control are essential in order to situate these industries within the broader context of Terminal Pleistocene industries of South Asia.

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Field Studies of Quaternary Sediments around Wai, District Satara, Maharashtra

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Abstract

Recent geoarchaeological studies of 20 m thick colluvial-alluvial deposits in the Krishna Valley around Wai, District Satara, Maharashtra, indicate that they can probably be assigned to the Middle Pleistocene. This inference is based on discovery of an *in situ* large Acheulian flake on basalt in a laterite-rich pebbly-cobbly gravel at Pachwad. Several geomorphological features of the landscape are misfit in the present geomorphic setting, and are the result of Quaternary tectonics and climatic change.

Introduction

Quaternary fluvial sediments in the Upland Deccan have been studied by many scholars (Rajaguru 1968, 1969, 1970, 1973, 1983; Rajaguru and Kale 1985; Rajaguru and Korisetter 1987; Kale and Rajaguru 1987, Rajaguru *et al.* 1993; Korisettar 1994; Umarjikar 1984). These sediments mostly occur in present-day river valleys. Based on their studies, Rajaguru and Kale (1987) divided Quaternary sediments into five litho units:- Bori Formation, Godavari Formation, Upper Bhima Formation, Chandanapuri Formation and Post-Black soil Formation. They assigned a major portion of the exposed deposits to the Late Quaternary. Their chronology was based on several of ^{14}C dates obtained on freshwater molluscan shells and drift wood fragments. A few Thorium-Uranium series dates were also obtained on calcretised sandy gravels. Their studies also showed that these rivers were primarily in an aggradational mode during the Terminal Pleistocene (~22,000 B.P. to 13,000 B.P.) as a response to weakening of the southwest monsoon. These streams were in an erosional mode during the early Holocene, due to a relatively strong southwest monsoon. Thus, it is clear that rivers particularly in Western Upland Maharashtra responded to global climatic changes during the Late Quaternary. However, Dole *et al.* (2002, 2005) argued against the climatic hypothesis of aggradational/erosional phases of the Upland rivers, particularly in the Pravara Basin. They carried out detailed morphotectonic and sedimentological studies on pre Quaternary basalts and Quaternary colluvio-alluvial sediments, respectively. These scholars stressed the role of tectonics in shaping landforms in the Pravara Basin, and suggested that the 'Pravara Gravel Formation' is a mapable unit belonging to the late Pleistocene.

Recently Petraglia *et al.* (2002) demonstrated that the fan-forming processes were dominant in the river Malaprabha, a southerly tributary of the Krishna, in Northern Karnataka during late Middle Pleistocene, and that the present course of the Malaprabha River is not older than the Late Pleistocene. With this background on Quaternary environment in the Upland Deccan, we carried out field studies in the source region of the Krishna River near Wai in 2007, to verify some of the new views mentioned above.

The Study Area

The town of Wai is historically famous. It is situated on the bank of river Krishna, a major river of Peninsular India. It is surrounded by Mandhardeo Hills, and Mahabaleshwar and Panchgani hill ranges to the north. The study area covers a stretch of 20 km along the river Krishna between Menavli (upstream) to Pachwad (downstream) (Fig.1). Geographically, the study area lies in the Upland Deccan, and is an erosional landscape developed over varieties of basalt of the Cretaceous-Eocene age. A significant feature of this landscape is step-like denudational surfaces with isolated laterite cappings of the Early to Mid Tertiary age. The Krishna and its main tributaries are allochthonous having their catchment zone in the Western Ghats. The drainage pattern is primarily dendritic and appears to have been controlled by joints and lineaments. These rivers are highly seasonal with floods during the monsoon. In general, these rivers occupy shallow box-shaped broad valleys and appear to be misfit in the present geomorphic setting. The channels of the river Krishna and its tributaries are presently entrenched either in bedrock or in colluvio-alluvial deposits. Climatically, the study area is in a semi-arid zone with a rainfall of 800 mm during the southwest monsoon.

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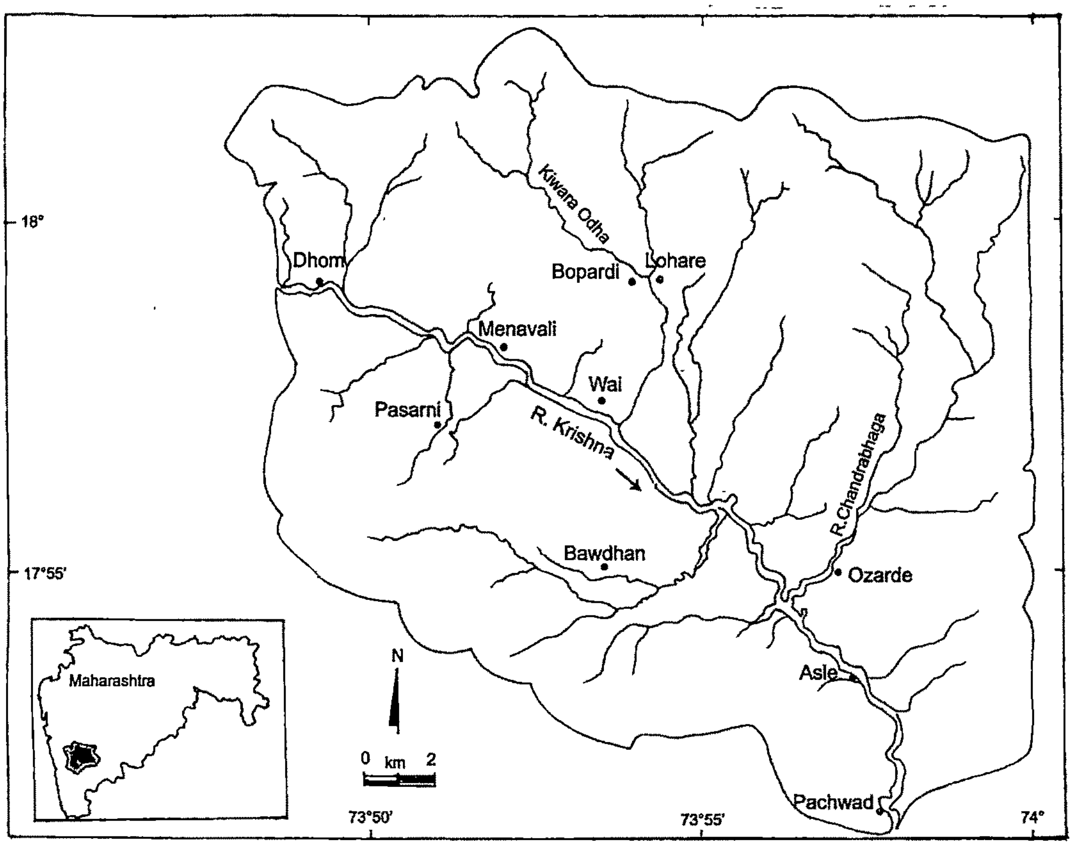

Fig. 1: Map showing the localities studied in the study area

Field Observations

Though earlier scholars have classified Quaternary sediments of the region into five major formations, our recent field observations show that it is difficult to classify those in this manner due to overlapping of several litho units, and varied thickness and lateral extension of each unit. Mishra *et al.* (2007) found that even Holocene deposits directly cap the Early Pleistocene deposits in the Karha Basin. Sometimes it was also observed that deposits of various ages without having distinct litho characters are juxtaposed over a very short distance. In this article we describe Quaternary sediments around Wai in terms of lithological units without assigning those a status of 'Formation', etc.

The source region of the river Krishna shows extensive alluvial surficial deposits on its banks. The Quaternary deposits in the study area have been described as comprising the following lithological units (Fig. 2):

Unit I	Pebbly-cobbly gravel with laterite
Unit II	Brownish/yellowish silt with interlayering sandy-pebbly gravel lenses
Unit III	Colluvial deposit
Unit IV	Brownish clayey silt without kankars

Unit I

This basal gravel rests uncoformably on bedrock basalt. It is well-exposed in the present channel of the Krishna at Menavli and Pachwad, and in the channel of Kiwara Odha, 0.5 km north of present Krishna river. This gravel is clast supported, poorly sorted and dominated by subrounded to rounded clasts of varieties of basalt, chalcedony and laterite. It is cemented by calcium carbonate within a matrix of sandy silt. The thickness of the gravel varies from 0.40 to 1 m and is disconformably overlain by brownish/yellowish silt (loam), i.e Unit II (Fig. 3, see cover 2).

On the right bank of the Krishna at Pachwad this gravel yielded an *in situ* basalt flake (Fig. 4, see cover 2). Recently, Sharon (2007) has coined a term 'Large Flake Acheulian Tradition' for such artefacts where the length is more than 10 cm. Therefore, this flake (13.93x8.21x2.31 cm) found at Pachwad belongs to this tradition. This flake is made on vesicular porphyritic basalt of grayish colour. It is slightly rolled with smoothened edges and has a thin, dark grey patina. The technology is simple, but not crude. The large flake from Pachwad is significant in this context. Such artefacts were also reported from Morgaon, an Early Acheulian site, district Pune. Mishra *et al.* (2008) argued that the finished tools often occur singly, dispersed

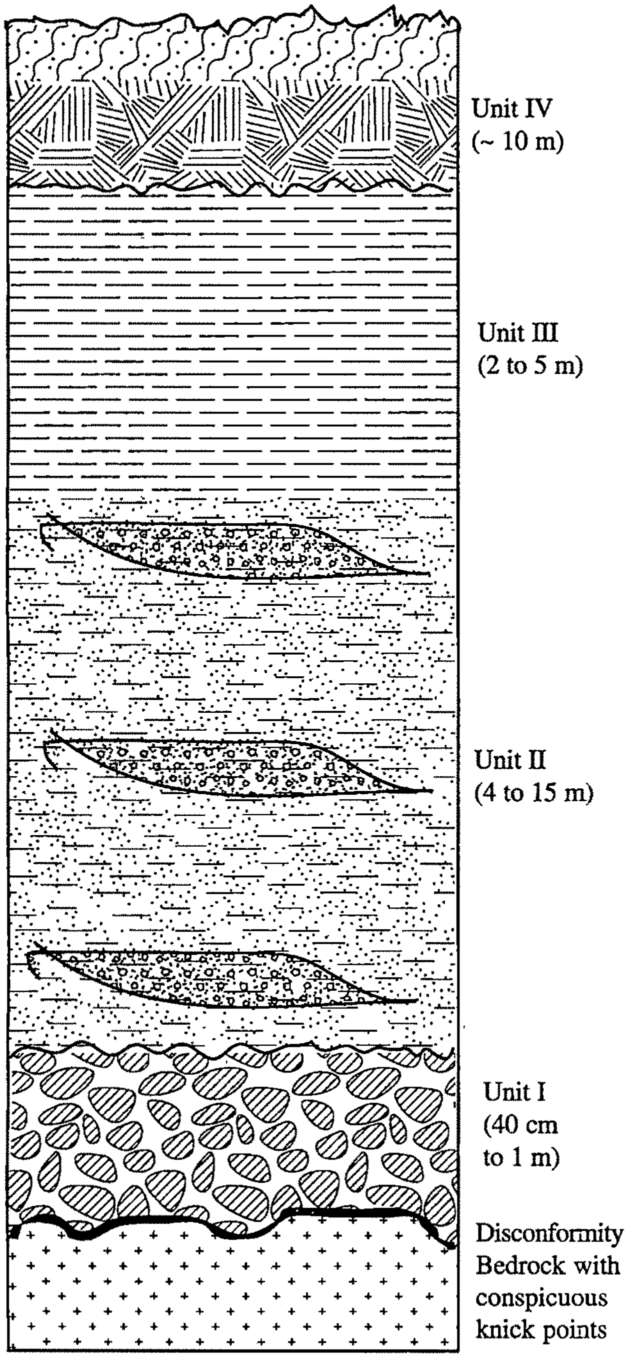

Fig. 2: Composite section showing Quaternary sediments in the study area (not to scale)

randomly over the landscape. It is not necessary that all stages of the complete *chaine operatoire* are found.

Unit II

The thickness of this unit varies from 4 to 15 m and is well-exposed at Kiwara Odha (Fig. 5, see cover 2) and Pachwad (Fig. 3, see cover 2). The top of this unit forms a distinct terrace surface with a lateral extension of about 2 km on both the banks of Kiwara Odha. A part of the old Wai town is situated on this terrace surface. Similar terrace surfaces are present at Menavli and Pachwad. The silt is texturally loamy, generally massive and contains nodules, rhizoconcretions and bedded layers of calcrete at various levels. These calcretes are of pedogenic and of ground water origin. At Kiwara Odha, the sandy-pebbly gravel lenses with laterite clasts were found to occur at 8 m and 12 m levels above the modern channel. At Menavli, on the right bank of the Krishna River, these gravels were found at 3 m and 5 m level. These gravels are clast supported, at places cross-bedded, laminated, moderately cemented by calcium carbonate and represent occasional strong high-energy flood surges during the aggradational phase of the Krishna. This silt unit also suggests that the aggradation occurred in response to loss of the transportation capacity of the Krishna River and its tributaries due to overall dry climatic conditions prevailing during the late Pleistocene (Rajaguru 1970; Kale and Rajaguru 1987). The silt deposition represents overbank near-channel flood deposition. This unit is of colluvio-alluvial origin.

Unit III

This unit was studied at the foot of the Wai-Pasarni Ghat, near town of Asle. At both places these deposits are about 2-5 m thick with a lateral extent of less than a kilometre. These deposits are being eroded by rain gullies originating in the nearby hills and provide a classic case of badland erosion. At some places these deposits inter-grade into alluvial deposits of the Krishna as observed at Menavli and in the Kiwara Odha. Generally the silts associated with the colluvium are yellowish-brown in colour. These contain lenses of poorly sorted, ungraded, angular to sub-angular gravels. Such gravels are often matrix supported and show a coarsening upward sequence. These gravels are dominated by locally derived basalt and are devoid of laterite clasts. Both silts and gravel are rich in nodules and bedded layers of calcrete of pedogenic and ground water origin. Joshi and Kale (1997) studied these deposits not only around Wai, but also in other parts of Maharashtra, and suggested that they represent a removal of thick regolith. The regolith covered slopes of the surrounding hills during the last interglacial when the climate was relatively wet.

Previously Joshi and Kale (1998) had collected microliths from the surface of these hill slope deposits around Wai. We also found a few microlithic made on chalcedony in the uppermost part of the hill slope colluvium at Bopardi and Lohare (Fig. 1). The basal part of the colluvium, however, has been dated to 75 ka by Th-Ur series of dating on carbonate nodules (Atkinson *et al.* 1990). At present there is no absolute date for the microlith-bearing upper most part of the colluvium.

Unit IV

This unit observed at Asle and Bawdhan is about 10 m thick. It forms an inset alluvial fill into the older late

Pleistocene fill of Unit II. The silt is almost devoid of any calcrete nodules. In its upper part it is capped by habitational debris of Early Historic and Medieval period at Bawdhan. The basal part of this unit at Asle has been dated to 10 ka on the basis ^{14}C date of shells embedded in the thin gravel lense (Rajaguru 1970) occurring close to the modern channel of Krishna. Both archaeological evidence and a single ^{14}C date assign the unit IV to early to mid Holocene.

Drainage basin analysis of the study area using topographic sheets (1:50,000 scale) showed that Kiwara Odha, a tributary of the Krishna, is a fifth order stream having a large number of low order streams (First Order streams = 242) and the trunk stream Krishna is a sixth order stream. The geomorphic parameters such as the drainage density (4.49 km^2) and bifurcation ratio (4.18) of the Kiwara Odha indicate maturity of the drainage basin.

Discussion

Generally, the source region of any river does not preserve colluvial and alluvial deposits due to intense erosional activity and heavy rainfall in the catchment area. Our obsevations around Wai show that exposed colluvio-alluvial deposits are 20 m thick with a lateral extension of 1.5 to 2 km. Such thick deposits have also been observed in the major rivers of Upland Maharashtra, such as those in Bhima and Godavari basins. Surprisingly, the middle reaches of these rivers in Karnataka and Andhra Pradesh have comparatively thin colluvio-alluvial deposits in a terrain underlain by Pre-Cambrian rocks, far older than the Deccan Traps. It is therefore, necessary to explain geomorphic anomalies observed in the river basins of the Deccan Upland.

As mentioned earlier, ubiquitous aggradation in most of the basins in the Upland Deccan is due to overall climatic aridity. Such aridity reduces the sediment transportation capacity of the river. This simple model of arid phase aggradation during the last glacial period and wet phase erosion in the early Holocene was challenged by Mishra *et al.* (2003) who pointed out that various streams have responded differently to the climatic change. The rivers with catchment in the humid Western Ghats were aggrading during the Last Glacial Maxima (LGM), while the rivers having their catchment in semi-arid zones were eroding due to the complex relationship of sediment load and discharge. However, this relationship is still not understood properly due to inadequate geochronological data. Similarly Dole *et al.* (2002) have explained unusual preservation of colluvio-alluvial deposits in the Pravara basin in terms of tectonics only and have rejected the climatic hypothesis proposed by other scholars.

Features like ungraded drainage of the river Krishna and its tributaries (Kiwara Odha), coalesced potholes (at Ozarde), and the occurrence of unusually large (30-40 cm) blocks of laterite in the alluvial fill of the Krishna (near Pasarni) suggest tectonic activity in the Krishna valley around Wai. The aggradation mode of the Krishna during the Late Pleistocene was certainly a response to Last Glacial aridity and is in tune with similar types of aggradation modes observed, not only in the river valleys of the Upland Deccan, but also in Peninsular India.

To sum up, one can state that the Quaternary deposits in the study area fluvial, colluvial and fluvio-colluvial. The evolution of landforms around Wai is a combined result of climatic change and tectonic activities in the region. Our studies around Wai suggests some role of tectonics in the

Table 1: Summary of field observations

Locality	Geomorphic/lithological unit	Geomorphic characters	Cultural material
Menavli	~ 10 m thick colluvioalluvial fill, on right bank of river Krishna	Alluvial gravel and colluvial gravel juxtaposed	nil
Kiwara Odha (nala)	~20 m thick colluioalluvial fill on both banks	Interbedding of alluvial and colluvial sediments, partially pedogenised	nil
Bhadreshawar, Ozarde	Coalesced potholes and rapids in bedrock basalt in the channel of the Krishna	-	nil
Pasarni	Hill slope colluvial deposit and alluvial fill	Internal intergrading of colluvial fill into alluvial fill on the left bank of the Krishna	nil
Bawdhan	Colluvio-alluvial fills with cut and fill structures	-	Habitation debirs of Early to Medieval period capping colluvioalluvial fill
Pachwad	Alluvial fill on both the banks of the Krishna.	Basal channel gravel with laterite clasts	*in situ* Acheulian flake

source region of the Krishna River during the Quaternary. It is as yet not possible to separate climatic factors from tectonics, as features like cut and fills within colluvio-alluvial deposits of Quaternary age are ubiquitously observed in most of the river basins of Deccan Peninsula irrespective of geological formations and structures. Therefore, there is definitely an important role of Quaternary climatic changes in shaping the landforms around Wai (Rajaguru 1970, Kale and Rajaguru 1987). It has also been observed that both the channel of the Krishna as well as its tributaries are ungraded, and remained ungraded since the Middle Pleistocene. Our observations show that the present channel of the Krishna has remained at the same level since the Middle Pleistocene.

This study is preliminary and therefore, it is not possible to draw any definite conclusions on Quaternary climatic changes and tectonic movements. We propose to continue our field studies in the source region of the Krishna and its tributaries in district Satara in near future.

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Microlithic Sites of Ayodhya Hills — Further Investigations at Mahadebbera

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Abstract

This work is the continuation of a post-doctoral project on understanding microlith-using cultures in the Ayodhya Hill region, Purulia district, West Bengal. Investigations undertaken in the field season 2006-07 were essentially two-pronged. Firstly, a probable raw material zone away from the area of occupation was identified on the basis of petrographic study of samples of raw material and those of artefacts. Secondly an intensive survey was done in continuation of previous explorations. An extensive occupation was marked at Mahadebbera. The nature of the site demanded an in-depth study of its topography, stratigraphy and cultural assemblage. This added to an understanding of the prehistoric landscape of the Ayodhya Hill region, necessitating more research in future.

Introduction

This work is part of an ongoing research to understand the relations between past human behaviour and the landscape from an in-depth study of microlithic sites located in the foothill region of the Ayodhya Hills. While explorations by previous scholars focused on isolated sites or occurrences of artefacts (Chakrabarti 1993), the aim here was to carry out an intensive exploration of the region, mark the nature of distribution of sites in relation to natural features in the landscape, and study their context within a multi-disciplinary perspective by taking a few trial trenches at chosen sites. Stone tools were the only cultural remains found at the sites. These were subjected to an analysis of the reduction procedure, which, it was felt, would yield the maximum possible information of past human behaviour. An ethnographic documentation of rituals and ceremonies prevalent among the local indigenous communities was done to understand the prevailing perceptions of the landscape and see how far that provided insights into past perceptions. Certain conclusions were reached on the basis of the work done so far (Basak 2001 and 2005). The current project is a continuation of this.

The Ayodhya Project: Methodology and Previous Work

Surveying the Ayodhya Hill Region

The complex of Ayodhya Hills and its foothill region, criss-crossed by numerous streams, cover an area of 600 km^2 of which only half has been surveyed in three field seasons. (1998-1999; 1999-2000; 2002-03). While surveying care was taken to mark the sites and scatters in relation to the natural features in the landscape. In recent times anthropologists working on landscape have highlighted significant natural features as repositories of symbolisms and special meanings. Landscape, in these works, has emerged as constituted by human dwelling, shaped by human choice and preferences. It is no longer seen only as a sum total of environmental features to which human beings adapt, but is conceived as a culturally constructed phenomenon, sharing a more intimate relation with its inhabitants.. Borrowing some of these notions archaeologists prefer to look at sites or 'places' in the landscape vis-a-vis outstanding natural features (see Basak 2005 for an elaborate discussion on these works). In the Ayodhya Hill region this was kept in mind while surveying. The distribution of the sites and scatters, numbering 24 is confined to an area of only 84 km^2. Four major zones of concentration were marked in the foothills of the Budha-ar, Kanapahar and Chauniya 'dungri' and in the headwaters of the Kumari, a tributary of Kansabati. These hills extend as spurs from the parent body of the Ayodhya Hills (Fig. 1) and emerge as significant features in the landscape along with some outstanding rocky outcrops present in the vicinity of the sites. A few isolated sites and scatters were also located in between these zones and sometimes away. All the sites and scatters were usually found on the banks of numerous streams draining the slopes of the hills which form a watershed between the drainage systems of the two principal rivers, Subarnarekha to the west and Kasai to the east. There were stretches where the artefact context was not exposed at all, and in some cases when exposed did not appear to show any artefact concentration.

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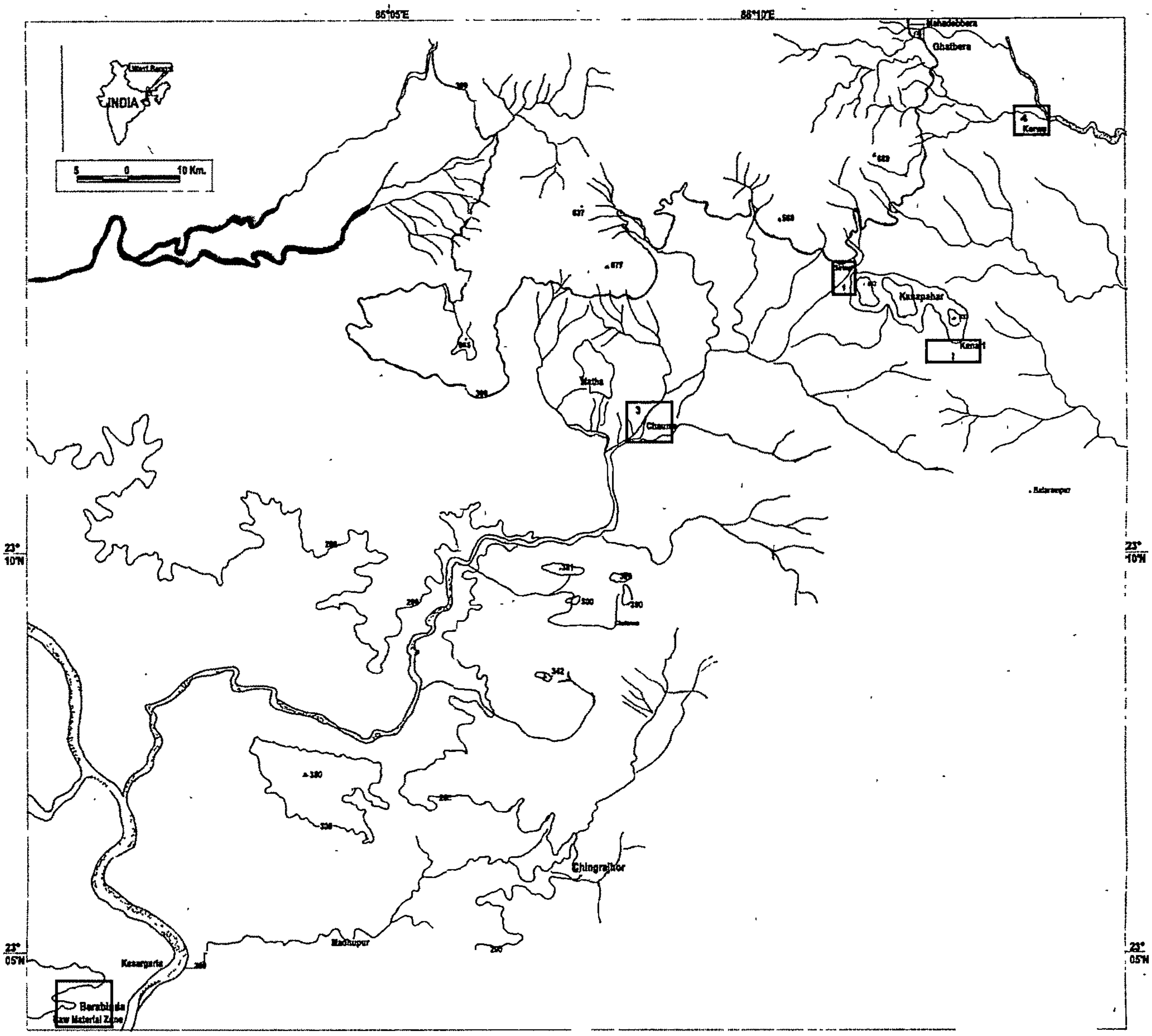

Fig. 1: Map of the Raw Material zone and four zones of sites in the Ayodhya Hill region

Studying the context

The context of the sites was studied by taking a few trial trenches at chosen places (Basak 2001a,b). All the sites/scatters are associated with a colluvial context, overlain by an oxisol and underlain by reddish silt. The stratigraphy bears a striking resemblance to the stratigraphy of microlithic sites/scatters in Tarafeni Valley, Midnapur (south of this region) where they were relatively dated to the Terminal Pleistocene (Basak 1997). On the basis of field observations and supporting evidence from Tarafeni Valley, the sites/scatters in the Ayodhya Hills have been assigned, approximately, to the same chronological period (Basak 2001a; Chattopadhyay *et al.* 2005).However, more advanced methodologies of sedimentological and chemical analysis are required along with OSL dating to confirm these field observations.

The social facts of technology

The concept of *Chaine operatoire* as a detailed study of all processes and stages of stone tool manufacturing, use, repair and discard was first introduced by the French anthropologist Andre Leroi-Gourhan who argued that this was the best way to understand the technical, social and symbolic behaviour of mankind (see Anne-Dobres 2000 for a detailed discussion). Ever since the latter's seminal work *Evolution et techniques* (1943) was published in France, scholars have used this research methodology, experimented with it, developed and modified it to delve deeper into the problem of solving the riddles of a prehistoric assemblage. Scholars working on biface technology or Levallois or on prismatic cores made for detachment of fine, regular blades have delineated sequential acts of stone tool production, 'flake by flake' right from the stage of acquisition of raw material to the ultimate discard of the artefact. Refitting, replication experiments of stone tools have been important aids. It is important to bear in mind here that there can be no fixed *chaine repertoire* for an assemblage, each has its own peculiarities and there can be several present on a site, depending on the strategies applied by the prehistoric populations in relation to different activities (Inizan *et al.* 1990). Questions of choices, preferences, constraints, cognitive abilities and the entire gamut of decision-making process of the prehistoric mind are sought to be explained through this methodology (see Gamble 1999 for a critical summary of the various readings of *Chaine operatoire*). It is needless to say that preservation of the archaeological record is an essential pre-condition to all such analyses.

Very often *Chaines* are established not only for a single site/locale but for several of those in a landscape (Finlay *et al.* 2000 a, 2000b). Although Mithen *et al.* preferred to interpret the artefact variability in terms of adaptive mechanisms of past hunter-gatherers in the Mesolithic landscape of Hebrides, Scotland, there remains the scope for other means of interpretation — can variability in the *chaine operatoire* between different sites in the landscape be explained only by differences in adaptation? How far can it be explained by the rationale of communication of skills between different social groups? If one is talking of social agency from technology (Anne-Dobres 2000) can one ignore past meanings, symbolisms which may grow around natural places in the landscape where many of these sites/locales are situated? How far can ethnography provide insights here?

Perhaps looking into all these aspects will render a more meaningful interpretation of the world of the prehistoric communities.

Following a 'flake by flake gesture' of the *Chaine operatoire* could not be followed in the absence of other aids like replication experiments, refitting and microwear studies. Instead a study of the lithic reduction sequence that was chiefly geared to the production of blade and blade tools was undertaken. The presence or absence of physical manifestations of the stages of reduction becomes meaningful in interpretation (Inizan *et al.* 1992). Detailed field surveys and assemblage analysis indicated that the initial stage of reduction is not represented as seen from the absence of raw material blocks, less percentage of preliminary decortification flakes and roughouts characteristic to this stage (Basak 2001a, 2001b, 2005). The four zones, in the vicinity of the hills, emerge as locales of intensive activity, characteristic to the post-manufacturing stage, not disregarding differences existing between the sites/scatters as well as minor ones with those few located outside the four zones. It was argued that these places were perhaps significant ones in the landscape which attracted repeated occupation in the past.

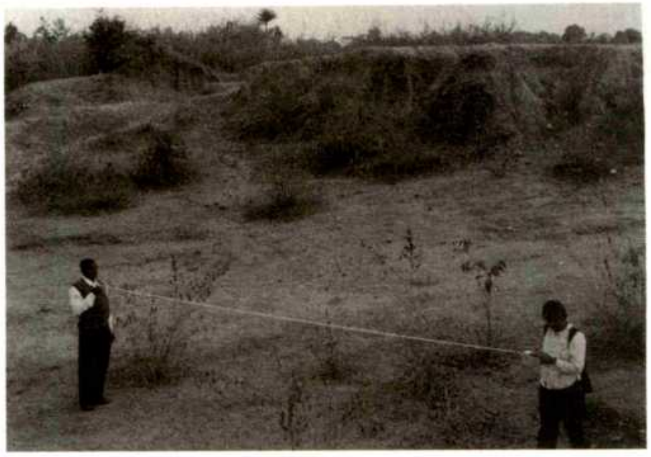

Fig. 2: The site of Mahadebbera

Tracing raw material outcrops

Availability of raw material is considered to be an important criterion that influenced people's movement across the landscape. A recent study has analyzed the proportion of raw materials present and utilized at Middle Palaeolithic sites in southwest France, this is taken to be true for Upper Palaeolithic sites as well that might be located in different regions (Geneste cited in Gamble 1999: 88). If the sources are within 5 km from the site they are 'local', if they are within 5-20 km from the site they are considered to be 'regional' and they are termed as 'distant' if they are traced at a distance of 30-80 km from the site.

The principal raw material used in the manufacture of the microlithic tools, i.e., rhyolite, could not be traced at the sites or in their vicinity. In course of previous surveys a source of rhyolite was traced at Dubrajpur and adjoining region, 4-8 km east of Chandil in Jharkhand (help received from Subhashish Sengupta, retd. Director, GSI for sharing information on the outcrops is acknowledged) and about 18-30 km as the crow flies from the four zones of concentration. A small proportion of chert, red chert and chalcedony were also used but their outcrops could not be traced here.

Ayodhya Project: 2006-07

The current project was divided into three stages:

1. Further exploration of the Ayodhya landscape for a better understanding of the distribution of the sites and for tracing the raw material outcrops,
2. Studying the context by taking a trial trench at one of the sites,
3. Making an in-depth analysis of the lithic material and interpreting the technology.

The Kumari catchment area and locating Mahadebbera

While exploring the remaining part of the Ayodhya landscape was an impossible one in course of one field season the unexplored area in the vicinity of one of the zones of concentration (Zone 4) was taken up, i.e. the headwaters of the Kumari River. Displaying a continuity of similar landform features seen in other parts of the landscape (Basak 2001a, 2001b) this region is also dominated by hills of an elevation of 300-600 m, where the principal geological formations are the Archaen and the Dharwar system dominated by quartzite, vein quartz, mica-schist, granite and granite-gneiss.

Previous surveys have revealed the potential of the catchment area of Kumari river where the extensive site of Kerwa is located. Following the low order streams upward from Kerwa an extensive microlithic site of 70 m^2 was discovered on the left bank of a stream, within 500 m north of Ghatberia village, in the middle of a forest land, now heavily denuded (Fig. 2). The area of the site along with the map is given below (see Appendix). The site, locally known as Mahadebbera, is marked by hill ranges to the west and north-west and by the isolated hill of Gajaburu to the north, located at a distance of approximately 2 km, as the crow flies, from the site. The location of the hill could be plotted on the topographic sheet where, however the name is not given. This hill is associated with myths and legends in popular folklore which try to explain its peculiar physical features. Rites and ceremonies are regularly held here on the first of *Magh* as observed at other hills in the region.

The colluvial context of the site (as seen in other sites of the Ayodhya foothill region) has been exposed due to deep undercutting of the overlying oxisol horizon creating extensive badland formations extending even beyond the site. The artefact concentration along with the badland features were mapped with the help of a Brunton compass, a measuring tape and a Global Positioning System (see Appendix). Artefacts were collected from the exposed context near each badland feature, as intensively as possible, with the intention of making the collection adequately representative. Groups of artefacts collected around each badland feature were analyzed as separate groups only to maintain a control over the analysis at this stage. Marking out separate activity areas is perhaps impossible without excavation, and more so, in such a heavily denuded topography. With the help of the GPS an attempt was made to see how far the altitude of the land influenced the exposure of the artefacts, if at all, thereby trying to explain the high and low density occurrences.

The artefact context has not been exposed at all in an area of 1 km^2 which is subject to cultivation east and south east of the site. The area to the north and northwest of the site needs to be taken up in future to check its potentiality.

Tracing the probable raw material zone

In recent years the study of raw material provenance has been intensively followed by geoarchaeologists (Malyk-Selivanova *et al.* 1998). While detailed provenance studies are beyond the scope of this project, an attempt was made to identify at least a few outcrops. Thus, following previous surveys done by the author, sources of rhyolite were traced in quarries near the villages of Barabinda and Natundih, 8-10 km northwest of Chandil in Singhbhum, Jharkhand, very close to the Bengal-Jharkhand border. Interestingly, geologists previously referred to rhyolite of this region as chert (personal communiaction: Dr. Sengupta, GSI) and therefore we find Pascoe (1973:208-209) mentioning that *cherts* (italics mine) and jaspers are of widespread occurrence in the Iron Ore series in Singhbhum and adjoining regions. The rhyolite occurs as a bed, showing variation from a dark glassy to a greyish ashy composition. Due to repeated quarrying activities by locals these outcrops found only in certain stretches might face extinction in near future.

These outcrops are situated at a distance of 18-30 km as the crow flies, from the four zones of concentration in the foothill region of the Ayodhya Hills (Outcrop-Zone 3= 18 km; Outcrop-Zones 1 and 2=24 km; Outcrops-Zone 4=30 km) (Fig. 1). Such outcrops may not be isolated occurrences and the presence of more cannot be ruled out.

Two samples of rhyolite extracted from the outcrop and three artefact samples from the sites of Chauniya (Zone 3), Siringi (Zone 1) and Kana 1 (Zone 2) were given to the Petrology division of the Geological Survey of India, eastern region, Kolkata. These were subjected to a detailed petrographic analysis which showed that all the samples.

All samples are extremely fine grained (microcrystalline). Of these, sample no. 1, 2, 4 and 5 are composed of feldspar and quartz. Biotite (black mica) forms about 10% by volume, while tiny flakes of muscovite (white mica) grains and acicular grains of tourmaline occur as minor constituents along with rare grains of iron oxide and epidote. Carbonate occurs as a minor secondary mineral phase. The feldspar and quartz in the groundmass are finely granular, and predominantly the grain diameter is < 0.025 mm and rarely up to 0.050 mm. The feldspar grains are untwined and have low optic axial angle which indicate that these are sanidine. The texture of these samples is finely equigranular. On the basis of overall mineral composition, texture and presence of sanidine as the dominant feldspar the rock type for all the four samples is Rhyolite.

Sample no. 3 is predominantly composed of feldspar and quartz with appreciable proportion of cryptoctystalline mass of biotite flakes and hornblende (?) and minor proportion of pyroxene (?), iron oxide, pyrite, and rare grains of tourmaline. Rare presence of carbonate, which occurs as a

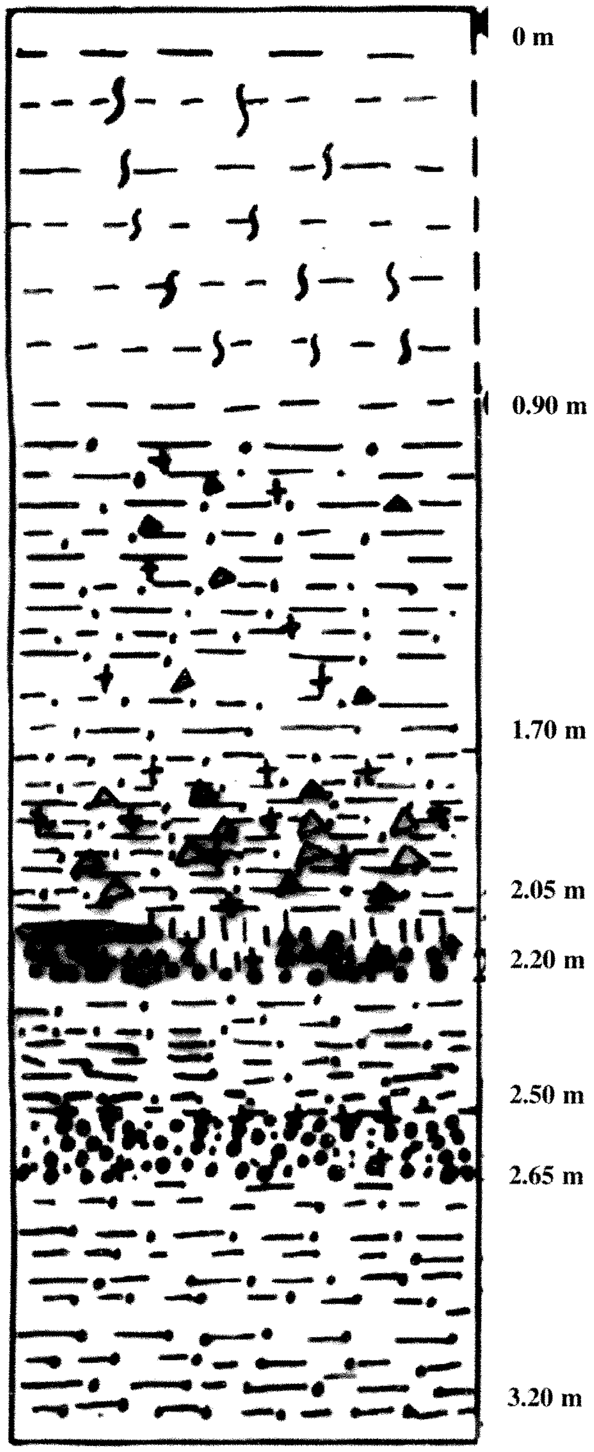

Fig. 3: Section at Mahadebbera

- 0-0.90 m
  Loose grayish mottled clay with roots, this unit was totally scrapped.
- 0. 90-1.70 m
  Mottled reddish sandy clay, more compact than above. Excellent pedal structures are seen in the form of irregular blocks. The presence of sand grains is possibly due to the presence of quartz and feldspar, derived from decomposition of the bedrock. From 1.70 m a few broken microliths and fragments of quartz start occurring. This level is at par with the microlithic context exposed at Badland 1.
- 1.70-2.05 m
  Compact reddish sandy clay is continuing. Quartz and microliths are found in more numbers.
- 2.05-2.20 m
  At 2.07 m a medium sized (35 x 14 cm) cobble of quartz was found. A concentration of colluvial material with a microlithic flake occurring in situ was found at 2.20 m. The colluvium, seen as occurring in patches within this unit consisted of quartz and schist cobbles as well as decomposed haematite blocks in a matrix of reddish, highly oxidized extremely compact sandy clay. This clay is often marked by greyish patches probably indicative of granite weathering. Microliths continue to occur in an isolated fashion. This layer appears to be at the same level as the context exposed at Badland 4.
- 2.20-2.50 m
  Compact sandy clay without any colluvial material or microliths.
- 2.50-2.65 m
  Here the nature of colluvium is changing slightly as the medium sized quartz cobbles seen earlier are now replaced by a gritty, pebbly material occurring in a similar matrix of reddish sandy compact clay. Concentrated blocks of such material were recovered with in situ microliths from the surface of this unit. This level is lower than the context exposed at Badland 4 but at a higher elevation than the context exposed near this Badland (3).
- 2.65-3.20m
  This unit is dominated by the presence of only reddish compact clay without colluvium or microliths. At 3.20 m the level of the microlithic context exposed near this badland was touched. This shows that this context has been washed out from above and re-deposited.

secondary mineral phase, has also been noted. The texture is fine grained pyroclastic dominantly formed by crystal fragments. On the basis of overall mineral composition, texture, and sanidine being the only feldspar it is concluded that the sample represents a Rhyolite crystal tuff.

While more samples could not be given for analysis due to financial constraints, this preliminary study helped to identify the probable raw material zone on the basis of similarities established between the raw material blocks and artefacts collected from sites in three different zones in the Ayodhya landscape. A naked-eye study of selected samples of artefacts from sites in Zone 4 and isolated sites/ scatters outside these zones also show similar features with the parent rock (personal communication, Sri P.K. Mukhopadhyay, Petrology division, GSI). However, these can only be scientifically established with more petrographic as well as detailed chemical analysis.

It is to be noted, that in the absence of intensive provenance survey the presence of a probable raw material zone is suggested. The importance of the study lies in the fact that raw material for manufacturing microliths was not available to the past population in the Ayodhya landscape or its near vicinity, it was transferred in some form from these or other similar outcrops.

More exploration is required, particularly of the region in the immediate vicinity of the raw material outcrops which will be taken up in future.

The microlithic context at Mahadebbera (Fig. 3)

In course of earlier filed seasons three sections at Kana 3, Chauniya and Kerwa were studied in detail. A trial trench was taken at Chauniya. On the basis of these field observations, a composite stratigraphy of about 6 m was drawn which revealed 3 m of moderately pedogenised (as indicated by gleying) clays as well as oxisols (depending on local geomorphology) overlying a microlith-bearing colluvial deposit of 50 cm-1 m. The erosion of this overlying pedogenised unit was exposing the microlithic context. This was underlain by 2 m (approximate) of strongly pedogenised gley or hydromorphic soils with lenses of clay and occasional inwash of colluvium, the entire unit overlying the weathered bedrock (Basak 2001b).

With these observations a trial trench was taken in a section of the badland at Mahadebbera. Due to severe undercutting the colluvial context appeared to be at different levels of elevation, which did not imply any time gap in their deposition, but pointed to the nature of erosional processes active in such a land surface.

A section of 3.20 m from the top surface in Badland 3 (marked in the site map: see appendix) was exposed. This was taken to be the representative section of the site and a detailed study of the units was undertaken in the field (see Fig. 3).

To conclude, this field study reveals the occurrence of fine grained silty clay or clayey silt inter-layered with gravelly, gritty unsorted sediments rich in microliths. The microlith bearing colluvium occur from 2.05-2.20 m and from 2.50-2.65 m. The oxisol does not cap the colluvial context at 3.20 m, but at 2.05 m and 2.50 m.

The reddish compact clay underlying the colluvial context and ultimately capping the bedrock at approximately 7 m has not been studied here. This pre-microlithic depositional unit is best exposed at Kana3. At the latter this pedogenised layer has developed over the bedrock and shows gleying at the base. This has intermittent colluvial layers and also a high amount of dark brown ferrugenous pellets. No obvious development of carbonate was seen in this unit.

Microliths occurring in two different colluvial units of the section may not be temporally distinct units, but were possibly the result of differential erosional and depositional processes. The coarse colluvial layers represented by both the gravelly as well as the gritty units represent strong intense erosional processes or sheet floods while the fine-grained silty clay indicates weak erosion and soil creep processes. Formation of such a hill slope colluvium is typical to sub-humid zones characterized by occasional dry spells. These changes in the intensity of erosional processes may suggest macro level hydrological changes related to the erosion of regolith capping the higher slopes of the Ayodhya Hill system.

The study of this lithological section confirms earlier conclusions based on studies of stratigraphy at Kerwa, Kana and Chauniya (Basak 2001a, b). Microliths in this region are uniformly associated with a colluvial layer which is a dramatic interlude between two phases of aggradation, more evident at Kana and Kerwa. The context is similar to that of Tarafeni Valley, Midnapur where it has been relatively dated to the Terminal Pleistocene (Basak *et al.* 1998) on the basis of associated faunal deposits and the formation of a calcrete profile. In the Ayodhya Hills the calcrete development is incipient and only concentrated in some places as lag deposits. This is due to the fact that the foothill region is an unstable surface unsuitable for such developments.

The Terminal Pleistocene or the Last Glacial Maximum was a time of global aridity, coinciding with weak summer monsoons. Similar type of colluvial gravels and silts were deposited during this period in the Garo Hills of Meghalaya and in the Imphal Valley of Manipur, both falling in the present humid zones of north east India (See Deo *et al.* 2004-05 for a detailed discussion).These signatures of aridity are considered to be significant all the more because they are found in the present humid zones.

However, the study of lithological sections at Mahadebbera, Chauniya, Kerwa and Kana is chiefly based on field observations. This only tentatively suggests—on the basis of similarities with the stratigraphic context in Tarafeni Valley and corresponding evidence from north eastern India – a chronology of Terminal Pleistocene and the presence of aridity during that period.

The reduction sequence at Mahadebbera

Absence of initial reduction

Absence of raw material outcrops in the near vicinity of the sites is also supported by the absence of initial reduction from the nodule which is generally true for all the sites as seen from an analysis of the debitage (Basak 2001a, b).

Primary reduction in a blade technology comprise signatures of acquisition and testing of raw material nodule, decortification as seen in the presence of primary (with 100% cortex cover) and secondary (with more than 50% cortex cover) decortification flakes, and possibly rough outs of blade cores and all the 'mistakes' characteristic to this stage of reduction (Binford and O'Connell 1984; Inizan 1992; Finlay *et al.* 2000). At the late Palaeolithic site of Baghor I in the Son Valley the assemblage chiefly consisted of debitage flakes, mostly cortical, chunks and large and thick blade and blade fragments, many with cortex on their dorsal surface — all being the products of initial stages of manufacturing, the finished products being taken elsewhere (Kenoyer *et al.* 1980: 128). However, sometimes, though rarely, nodules with internal faults and natural flaws have been found at sites, at least 29 km from the source (Barton *et al.* 1995). Low cost of transporting raw material probably owing to the use of canoes and dogs was given as a possible explanation.

At Mahadebbera such indicators of on-place reduction of nodule are absent. No raw material nodules of rhyolite have been found either (Fig. 4) While rhyolite is the dominant material utilized a very nominal presence of few other groups of raw material is noted — 0.2% of black chert; 0.3% of red chert; green chert, chalcedony and opaque quartz are each represented by a single specimen or 0.07% each. None of these groups are represented by any raw material nodule. The number of cortical flakes present is also insubstantial, only 23% or 200 out of a total of 868 flakes (Fig. 5). Even amongst these primary or secondary decortification flakes are absent. All the flakes including a few large ones (68 or 7.8% of the total) have a cortex cover of 0-50% (Fig. 5) and Table 1. A part of these flakes may have resulted from attempts at blade reduction from cores many of which retain cortex on their dorsal surface till a late stage of reduction.

Table 1: Size-wise distribution of flakes

Flakes	**No.**	**%**
Large flakes (4-6 cm)	68	7.8
Cortical	30	3.4
Medium flakes (2-4 cm)	616	70.9
Cortical	152	17.5
Small flakes (=< 2 cm)	184	21.1
Cortical	20	2.3

Finlay *et al.* (2000) have categorized non-cortical flakes as evidence of tertiary removal. Following this, it may be said that mostly tertiary stages of reduction were present at Mahadebbera when 77% of the flaking debitage was non-cortical.

The Stages of Reduction Present at the Site

In the absence of raw material sources the obvious question would be in what form it was transported to the site. Inizan *et al.* (1992) offer the following options:

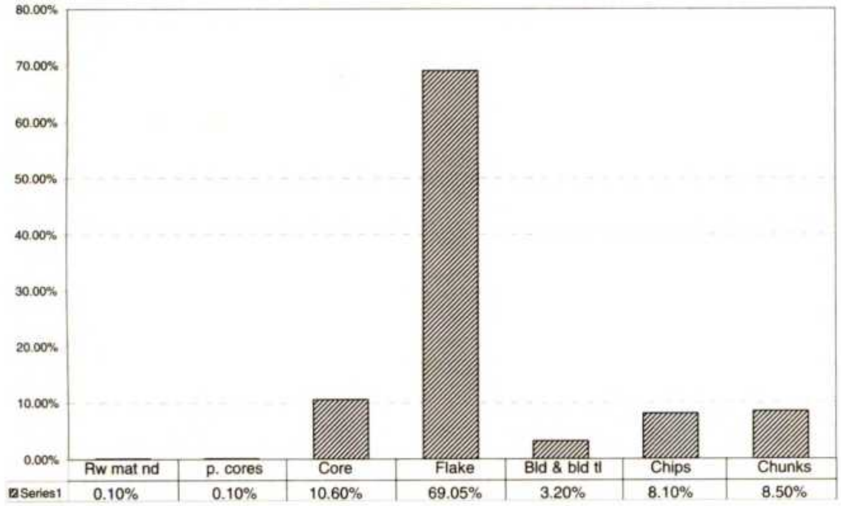

Fig. 4: Artefact groups

(i) The material is taken to the campsite in an unmodified or slightly modified state; therefore the debitage will be characterized by unmodified or slightly tested blocks, preformed cores, shaping flakes, cores during or after flaking, characteristic pieces, unretouched byproducts and finished tools.

(ii) The material is taken to the campsite in the form of preformed cores (unflaked) and/or preformed bifacial pieces (unfinished). The latter obviously refers to a biface technology. The debitage will be characterized by all of the above excepting unmodified blocks of raw material.

(iii) Only raw debitage products and /or preforms of bifacial pieces are brought to the site. In that case unmodified blocks, preformed cores and shaping flakes will be missing and possibly left near/at the quarry sites. Cores and characteristic pieces may be present, unretouched by products and finished tools will definitely be present.

(iv) Only retouched/unretouched tools are taken to the camp, in case of a biface technology finished bifacial pieces are also likely to be found.

These four options are obviously certain hypotheses that have been put forth by the authors who were engaged in experimental knapping. The exact situation present at a site may be a modification of any of the above, including slight alterations.

Mahadebbera is characterized by cores in different stages of reduction (10.6% or 134), 0.1% (or 2) of preformed cores, 0.1% (or 2) of trimmed nodules, 69.05% of flaking by products, 3.2% (41) of blade and blade tools, 8.1% and 8.5% of chips and chunks respectively (Fig. 4). The raw material was possibly transported to the site in the form of preformed cores or partially made cores which were further reduced at the site. A few large manufacturing flakes with blade scars are present (4.6% or 40) whose size do not match with the cores. Only 0.7% of these show a cortex cover of 0-50%, ruling out the possibility of them being by-products of primary reduction. They may have been brought to the site for some purpose or they may have been by-products of subsequent stages of reduction of cores on site that were later taken away.

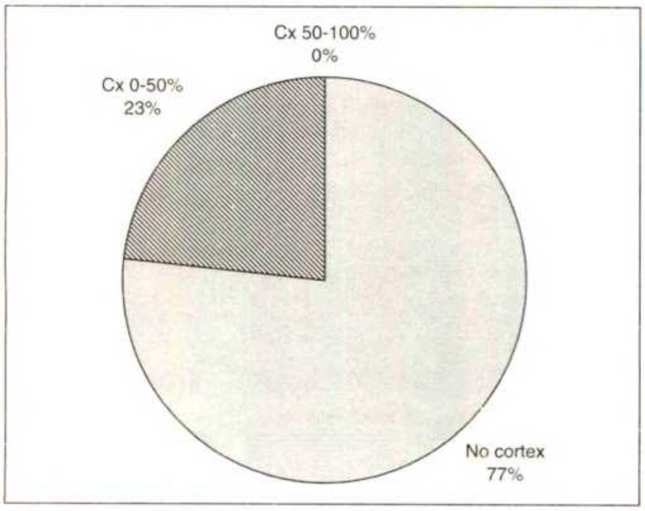

Fig. 5: Cortical and non-cortical flakes

In order to understand the post-primary reduction phase present at the site certain principles of analysis were adopted. As blade cores form an extremely important category in a technology geared to the production of blades and blade tools, it was necessary to assess their intensity of reduction. Finlay *et al*. (2000) tried to look at core stages in their analysis of cores. A core that was finally abandoned at the site may not only reflect the stage just prior to its reduction, but also earlier stages. On any one core several stages of reduction may be evident in technical decisions to work the core in another manner, such as by utilizing a second platform or multiple platforms or by adopting a bipolar method. (Here, the second alternative may be rejected as there is no evidence of bipolar technique at all). There are cases when only one stage may be evident on the core, this might be because the entire core was worked in a singular fashion or because the final removal obliterated all traces of earlier stages of core use. Here the number of platforms per core has been taken note of. Intensity of core reduction is also assessed by its length and the number of scars present at the time of abandonment. A core was classified as minimally used when there were still perfectly usable angles left to remove more blanks and it showed only one or two scars coming from one platform. It was called well-exploited when the number of scars left on it were more (three-seven) but there were still usable angles remaining. When the angles left on the platform (s) were such that no further removal of blanks was possible then it was considered to be exhausted (Johnson 1975). Rejuvenation or maintenance of cores through restoration of the platform angle or the desired platform edge can also be seen in a high incidence of platform and core rejuvenation flakes. Defects in the raw material or flaws in knapping, in most cases seen in the form of step/hinge fractures, were noted to see how far this was a hindrance in core reduction and to what extent it influenced core abandonment.

Table 2: Flake types represented at the site

Types of flakes	**No.**	**%**
Large manufacturing flakes	40	4.6
Ambiguous Flakes	9	1.03
Rejuvenation Flakes	8	0.9
Core flakes	3	0.3
Unretouched flakes with use marks	1	0.1
Other flaking by-products	807	92.9

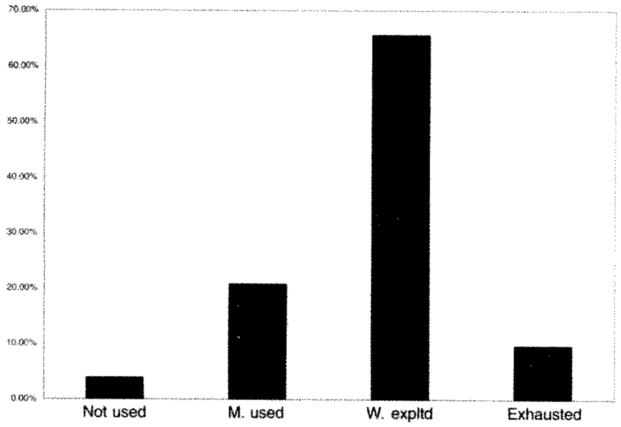

Fig. 6: Exploitation of cores

As all the flakes are a by-product of the blade reduction process a comparative ratio of the cores and flakes would show whether more cores were brought into the site or less cores were discarded, some being taken away (Basak 1997). The state of exploitation of cores and the nature of the flakes need to be taken into consideration here.

A broad classification of flakes was done according to size (Table 1) and general types which were further classified as follows (Table 2): ambiguous flakes or flakes without any blade scars, large manufacturing flakes or flakes occurring in the early stages of reduction, rejuvenation flakes, core flakes and other flaking by products occurring through out the reduction process. The nature and extent of utilization of the flaking debitage was also assessed from serreted marks (when present on the margins of the flakes), deliberate modification and definite retouching. The obvious limitation here was the absence of micro wear studies without which nothing more conclusive can be said.

A study of the assemblage has clearly shown that the knapping process was intended to produce blade blanks, some of which were retouched to make blade tools or microliths. None of these were on flakes. These were classified according to length and types. Blade blanks and microliths found at the site seldom give a true picture of the number of blades extracted as these are small, light implements that are mostly hafted (in case of the microliths) and are more prone to wear, tear and loss as they are carried around by mobile populations (Ebert 1979: 68). Therefore a ratio of blade scars/blades, although noted here, gives only a partial picture. Although edge damage on the blades was noted, definite retouching and backing were taken as marks of utilization in the absence of micro wear studies.

Intensity of core reduction

Blade cores with single platform dominate (n=71, 52.9%) followed by those with double platform (n=54, 40.2%) and multiple platform (n= 8,5.9%). In a single case the nature of platform could not be determined. Amongst cores with double platforms there is a minor distinction as seen from the pattern of blade scars, in 47 cases blades were removed from platforms opposed to each other, while in 8 cases they were removed from platforms in two directions.

We have to bear in mind the complexities of seeing intensity of core reduction from the presence of platforms and direction of blade removal as noted above. The choice of changing the direction of blade removal may sometimes be also determined by the quality of raw material and knapping skill. A poor quality raw material may not allow the knapper to prepare the platform carefully thus enabling him to remove a large number of blades or blanks from that one platform or core stage.

Keeping these parameters in mind the intensity of core reduction appears to be quite high when 46% (taking the double and multiple platforms together) of the cores show 2 or more stages of working.

The nature of exploitation of cores is explained in Table 3 and Fig. 6. 65.6% of the cores were abandoned in a well-exploited state, 9.7% in an exhausted state, 20.8% in a minimally used state and 3.9% in an unutilized state. Size wise the maximum number of cores were abandoned in the 2-3 cm category. It is to be noted that the minimally used cores are in an intermediary or late stage of reduction viz., the 3-4 or 2-3 cm category.

The possible reasons for their abandonment without further exploitation may have been either due to flaws in knapping or defects in the raw material or a combination of both, or some other factors. 47.7% of the cores show defects in the form of hinge fractures. Without experimental knapping from the raw material it is difficult to come to any conclusions about the skill or expertise of the prehistoric knapper (Inizan *et al.* 1992) and to what extent his technique was affected by defects in the material. Among the 5 unutilized cores one is a core with a prepared platform (4-5 cm category) without any defect. This clearly shows that reasons for abandonment of cores with minimum/no use may not always be accessible to the archaeologist. An analysis of the well-exploited cores

Table 3: The nature of exploitation of cores

Length (cm)	Minimally Used	Well-Exploited	Exhausted	Not Used
4-5	2	5	0	2
3-4	11	38	0	0
2-3	15	45	8	3
1-2	0	0	5	0

shows that many times defects in the raw material were overcome in adequate reduction. Hinge fractures were sometimes seen as deterrents in cores categorized as exhausted.

A few other mechanisms of blade removal were seen. 5.9% of the cores were chunks that were used to extract blades. Decortified nodules trimmed to extract blades formed 0.1% of the total artefact groups while core flakes formed 0.3% of the total number of flakes. Although nominally represented, these groups point to alternative ways of reduction when adequate raw material was not available. This also points to recycling of the debitage. Recycling activity is also found in the use of abandoned cores, although such examples are very few, only one core was retouched for use.

The average blade scar per core is 3.4, however, this only points to the situation at the point of discard. Also exhausted cores reveal very few scars on the dorsal surface.

Rejuvenation or maintenance of cores is nominal, as represented by only 0.9% of platform and core rejuvenation flakes, this being a part of the total number of flakes present at the site.

To sum up, slightly less than half of the cores show 2 or more stages of working; although the maximum number of cores were discarded in the intermediate or late stages of reduction all were not discarded in an exhausted state, and only a small percentage of cores, i.e., 3.7% were discarded in the 1-2 cm category in an exhausted state; maintenance activity was nominal; a few alternative ways of blade reduction were explored. Overall this implies a moderately intensive reduction of cores (Fig. 7) which can be better established by comparative studies with other sites in the landscape. Non availability of raw material may have determined the intensity of core reduction to a certain extent but not fully. It would be interesting to compare Mahadebbera with Chauniya, which is located in a closer proximity to the raw material zone and see how far that influenced core reduction at the site.

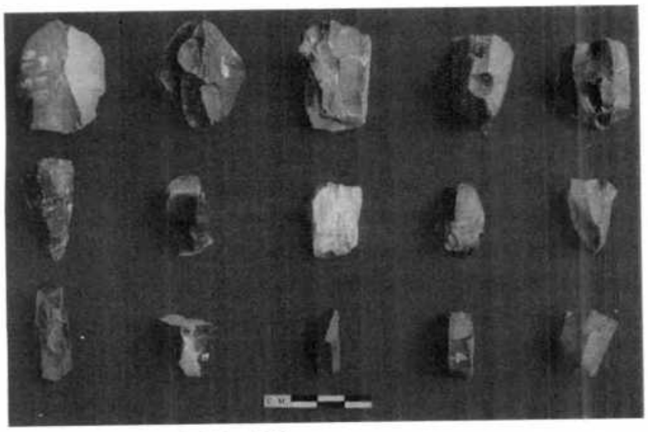

Fig. 7: Cores at Mahadebbera

A logical corollary to this would be to understand why a core was abandoned when it was not fully exhausted. The presence of hinge fractures — related to flawed knapping/ natural defects/combination of both — and the inability to successfully perform the task of blade reduction to the last were the possible reasons in most cases while for the others there were no apparent reasons for abandonment.

Here a brief note about the technique may be made. Inizan *et al.* (1992) distinguish between a pressure flaked blade core and a percussion-flaked blade core by the presence of very straight and parallel rises in the former indicating maximum precision and standardization of the raw material. By this criterion none of the cores present here were pressure-flaked. They were likely to have been produced by indirect percussion or possibly direct percussion by soft hammer in a few cases. In very few cases blade reduction was accomplished by holding the core in hand a seen from two examples where space for hand rest is evident on the ventral surface. Without experimentation nothing further can be said.

The flaking debitage

The large manufacturing flakes remain a puzzle. As already seen only 0.7% of these are cortical with a cortex cover of 0-50%. Only one shows possible marks of utilization, thus it cannot be established that these flakes were brought to the site for use. Their size (a few being more than 7 cm) does not match the size of the cores present. They may have formed a part of the debitage of cores that were subsequently transported, therefore the blade cores left at the site in the intermediate or late stages of reduction represent a biased picture of the knapping that took place at the site. An almost similar situation has been mentioned by Finlay *et al.* (2000: 569). It has been also mentioned above that a part of them may have been brought to the site with the preformed or partially made cores for some unforeseen reason. The presence of large ambiguous flakes cannot be explained, it is obvious they did not form a part of the reduction process at the site.

Signs of utilization in the form of serrated marks, deliberate modification where flakes were intentionally shaped were present on only 1.3% (12) of the samples while marginal retouching was seen on 0.3% (2). These were mostly seen on the other flaking byproducts in the medium flake category.

Core/flake ratio

The existing core/flake ratio at the site is 1:6, which suggests that although primary manufacturing activity was missing secondary or tertiary reduction activity was present. A section of the cores were possibly taken away, which is also suggested by the presence of the large manufacturing flakes. Thus cores discarded at the site give only a partial picture.

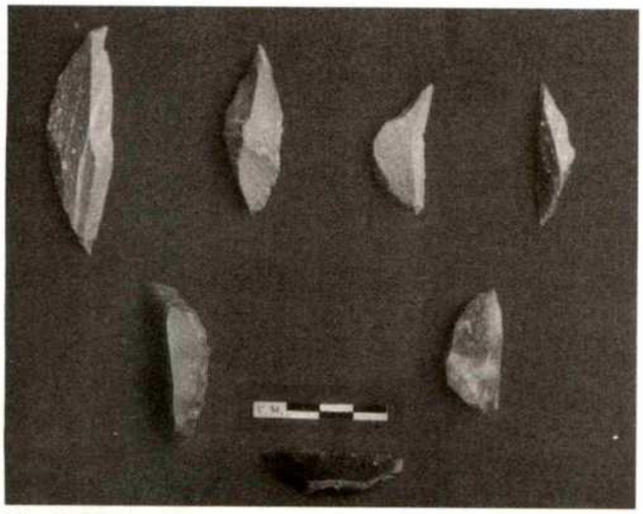

Fig. 8: Blade tools at Mahadebbera

Utilization of blades

Simple blades (18) of which only one specimen shows retouching form the bulk. Backed blades (13) form the best represented category among blade tools, followed by points (5), lunates (4) and a single triangle (1) (Fig. 8). Size-wise the 1-2 cm group predominates (20), followed by blade and blade tools in the 2-3 cm category (16). Taking everything into consideration most blade and blade tools are likely to be in the 2-3 cm category. Size-wise the maximum number of cores discarded is also in the 2-3 cm category. However, the number of blade and blade tools left at the site is much less as seen from the blade scare/ blade ratio i.e., 281:41 for reasons which have been explained above.

Conclusions

The artefact analysis suggests that secondary or tertiary stages of reduction were present at the site. A general comparative study between different sites has been given elsewhere (Basak 2001a, b), a more detailed study of assemblages from sites in the different zones of concentration is likely to show varied pattern in the post-manufacturing stages. It has been established through the petrogaphic analysis that raw material used in the manufacturing of the microliths was possibly acquired from a probable zone, approximately 30 km away from the site. Going by the categorization given by Geneste (see above for a discussion) on the basis of distance such sources could be classified as 'distant'. Ethnographic examples of acquisition of distant sources of raw material are not rare. The question remains as to why these sites were occupied. These places may have been favourable locales for hunting, which over the years possibly became laden with special meanings (Basak 2005).

The area between the sites and the probable raw material zone was surveyed to see if any site could be located with remains of primary manufacturing sequence. However, no exposed colluvial surface associated with the microlithic sites or any outstanding natural feature observed at all the sites could be traced here. This region, intensively cultivated, appears to be geomorphologically younger than the artifact-bearing zones.

A comparative study of stratigraphy on a preliminary basis between sites in the Ayodhya hilly region and the Tarafeni Valley in northwest Midnapore suggests aridity in the Terminal Pleistocene. However more work is required to establish this suggestion on firm grounds.

As only half of the Ayodhya landscape could be intensively surveyed so far, only a partial understanding of the past use of landscape can be formed. More exploration along with taking a few trial trenches at selected sites will yield a holistic picture.

Acknowledgements

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Appendix

The Sitemap of Mahadebbera

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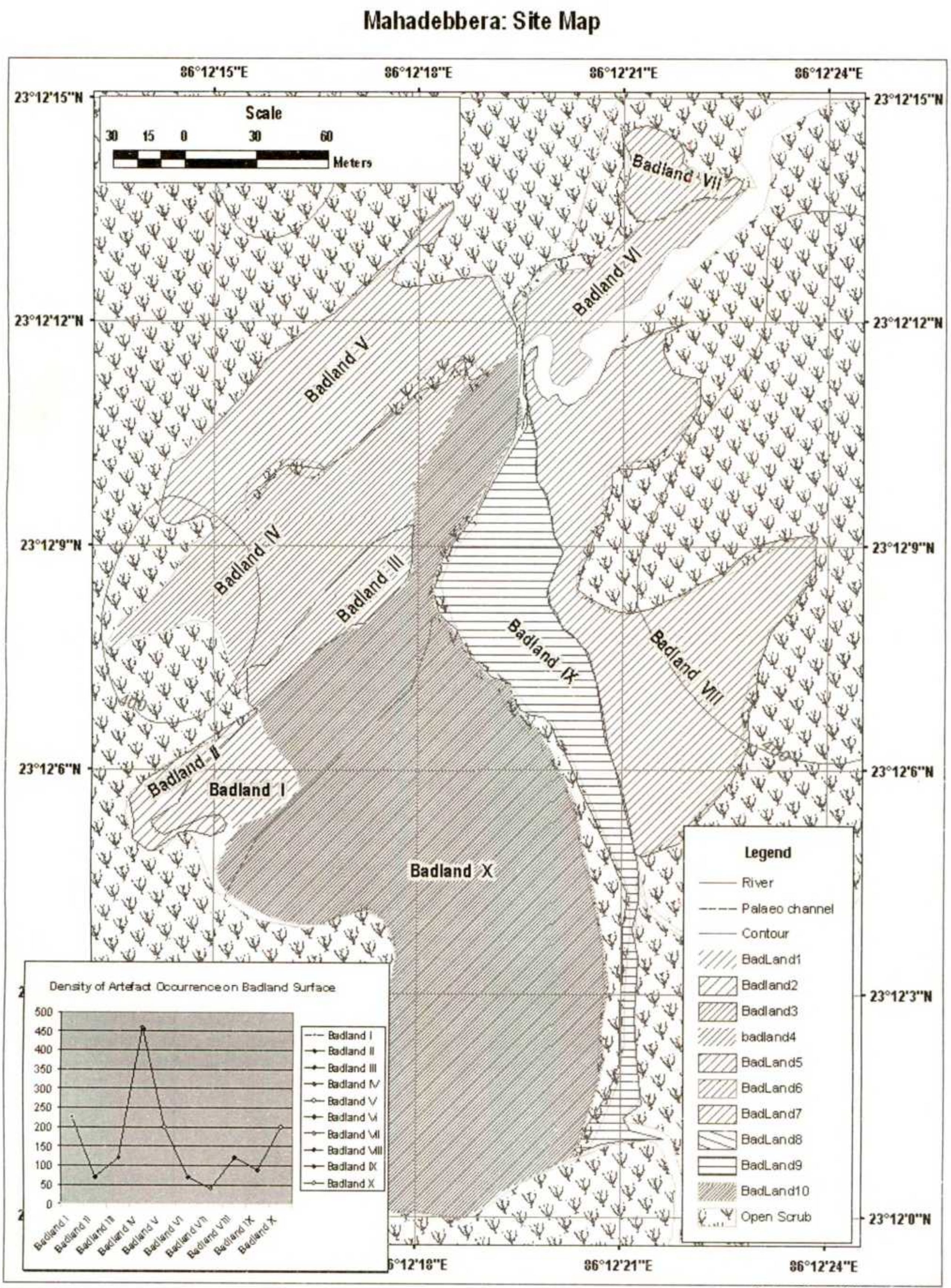
The microlithic site Mahadebbera has a *badland* topographic feature and it is near Ghatbera village (JL. No. 1) which is under the jurisdiction of Balarampur police station in the distirct of Purulia, West Bengal. The ground control survey of the site was conducted employing chain, compass and GPS (Geographical Position System). The Survey of India Toposheet no.73 I/4 (1:50,000) and the Satellite data TM Landsat VII have also been used for



Based on SOI map 73I/4 and survey data

Fig. 9: Mahadebbera site map

preparing the site-map. The topographic map has been used as a base for digitization of the field coverage area, allowing togenerate A4 size (11.7" x 8.25") field maps, showing vector features overlaid on the topographic map base accompanied by the satellite data of the particular area.

Location of the Survey Area

The total area covered in the survey was roughly 70,735.970693 m^2 (i.e. 0.070736 km^2). It is a catchment area of the river Kumari. The whole badland area of the site Mahadebbera has been exposed due to recent erosional processes and is surrounded by a huge open scrub area.

Method of Survey

The survey started from the confluence point of the river Kumari and its distributary to the south of the Gajaburu hill. It progressed in the northeast direction where a palaeo-channel of a first order stream of the river Kumari was traced.

One of the first steps taken in surveying was to obtain existing control points in the Topographic sheet of the area of interest. Once this was accomplished, field reconnaissance was performed in an attempt to locate those control points. There were three control points. At first, the road crossing point of the village Ghatbera as derived from the Toposheet was taken as the base-point for the survey. The point is at 300 m elevation (msl) and at 23° 11.646 N and 86° 11.755 E. The confluence point of the river Kumari and its distributary was taken as the other location point employing the GPS and the point is at 295 m elevation (AMSL) and at 23° 11' 55.163" N and 86° 12' 21.445" E. The third and final control point identified using the GPS was the confluence of the two first order streams and the point is at 310 m elevation (AMSL) and is at 23° 12' 11.851"N and 86° 12' 19.456" E. From these three control points, the site Mahadebbera could be best located at and from 23° 11'55.163" to 23°12' 11.851" N and 86° 12'21.445" to 86° 12' 19.456"E.

A two-fold survey method was adopted. The traverse network was laid out using chain and compass through a line of the badland area. At first, the vicinity of the total survey area was traversed in a random way. Then angles and distances of the entire traverse network were accurately measured by tape and Brunton compass. The main traverse loop was closed around major cultural features, viz. the artefacts and then several traverse *'spurs'* off the main loop were recognized for mapping each badland feature according to the occurrence of artefacts found near each. Then Garmin GPS 20 was used which helped in preparing the site map promptly and with reasonable precision (Table 4).

Table 4: Locations of Badland I to X

Site	**Easting (Precision) 86° 12' +**	**Northing (Precision) 23° 12' +**	**Elevation (m)**
Badland I	15.341"	5.649"	304
Badland II	13.99"	5.45"	304
Badland III	16.836"	8.163"	306
Badland IV	15.18"	8.626"	310
Badland V	17.306"	11.629"	310
Badland VI	20.815"	12.353"	311
Badland VII	21.389"	13.711"	312
Badland VIII	21.01"	7.315"	306
Badland IX	19.533"	7.609"	305
Badland X	17.462"	7.294"	304

The microlithic find spots at the site Mahadebbera were broadly found distributed in ten badland areas. The survey progressed from the point of smaller artefact concentration zone to the larger one and at the Badland IV, the highest concentration of artefacts was found (Fig. 9). Badland IV is at an elevation of 400 m (msl) and the slope tends south-east. A total of 25 traverse points were established at the site Mahadebbera. Over 220 field shots (with their coordinates) were recorded to create the topographic map of the site.

Application of the Mapping Software

The collected field data has been first converted into the Excel format. The sitemap has been made in AutoCAD Map and then converted into ArcGIS to accommodate all landscape features (open scrub, streams, palaeochannels, contour lines, etc.). This intensive approach is, however, quite time-consuming; but for the detailed study of the landscape of the site it is of paramount importance.

The topographic sheet and TM data have been geo-referenced using ERDAS Imagine in polyconic projection system and then are exported to GEO database, following which the survey map as well as landscape features can be visualized in one layer (Fig. 9).

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Faunal Remains from Neolithic-Chalcolithic Phases at Tokwa, Mirzapur District, Uttar Pradesh

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Abstract

A total of 559 fragments of animal bones and other animal skeletal elements recovered from Tokwa (Mirzapur District, U.P.) were analysed using a standard protocol developed at the Archaeozoology Laboratory of the Deccan College, Pune. The basic identification was carried out at Allahabad, and only a few fragments were brought to the Deccan College for detailed studies and to consult the reference collection. Processing of the data was done at the Deccan College using the computer-based system of analysis. The study revealed presence of only two domestic species - cattle and goat in the Neolithic phase. The wild mammals identified in the Neolithic context are gaur, nilgai, blackbuck, spotted deer, sambar, porcupine, house rat, and the bandicoot rat, jungle fowl, peafowl, Saras crane, crocodile, monitor lizard, freshwater cat fish, rohu and freshwater mussel. In the Chalcolithic phase the buffalo, domestic pig, sheep and domestic ass were found in addition to the cattle and goat. The wild or domestic status of the buffaloes could not be ascertained. The spectrum of wild animals is much narrower than the Neolithic phase. Only four wild mammals were found in this phase – the gaur, blackbuck, four-horned antelope and spotted deer.

Introduction

The site of Tokwa (24° 54' 20" N; 82° 16' 45" E), Mirzapur district, Uttar Pradesh, is located 68 km southeast of the Mirzapur district headquarters. The site is situated at the confluence of the Belan and Adwa rivers (Fig. 1); with the Belan flowing to the north nd the Adwa River to the south of the site. On the western side of the site, the two rivers meet at an acute angle. The extant site though eroded by these two rivers, is spread over an area of approximately 6 ha. The thickness of the cultural deposit was found to be about 4 m.

Tokwa was reported first by Sri B.B. Misra, of the Department of Ancient History, Culture and Archaeology, University of Allahabad, Allahabad. Singh (1996) while doing his doctoral dissertation discussed archaeological finds from this site. Exploration at the site in 1999 by archaeologists of the Allahabad University (Misra *et al.* 2001) resulted in the discovery of Neolithic and Chalcolithic ceramics and animal bone fragments. Tokwa was excavated by the Allahabad University in 2000 (Misra *et al.* 2000-2001) and 2003 (Misra *et al.* 2004).

Three trenches (H8, H9 each measuring 5 x 5 m, and a control pit of 1 x 1 m) were excavated in 2000 (Fig. 2-3). In 2003 two more trenches I-8 and I-9 measuring 5 x 5 m were excavated. Square E-4 of trench C-9 was also excavated to know the nature of deposits towards the bank of the river Adwa. The excavation revealed the presence of habitation deposits divisible into sixteen layers. Layers 5 to 16 belonged to the Neolithic and Chalcolithic phases. The ceramic assemblage of the site is divisible into two groups (Misra *et al.* 2000). The first group is ascribed to the Neolithic phase of the Vindhyas. It consists of cord-impressed pottery and potsherds with rustication in their lower outer portion. This pottery is handmade, devoid of any paintings, and the core is gritty. Occasionally, the firing was not perfect. Rice husks have been found incorporated in some sherds. Pottery types in this group are limited – bowls of different categories, medium-sized vases, storage jars, etc. The second group of pottery consisted of Black slipped ware, Black- and- Red ware and Red ware. Generally, the pottery of this group is wheel-made, but a few hand-made specimens are also present. Generally the clay used for the manufacture of pots is levigated, and the pots are well-fired. Paintings are absent, but a few with decorative patterns were found. Besides pottery, microliths, bone arrowheads, beads, querns and mullers and faunal and floral remains were found at Tokwa. Six radiocarbon dates of charcoal samples from different levels from Tokwa are available (Table 1).

Among the dates from the Neolithic level only one (BS-2369) gives an early dates which corresponds to other

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Table 1: ^{14}C radiocarbon dates of charcoal samples from Tokwa

Trench	Layer	Lab No. BSIP	^{14}C date (yrs BP)	Calibrated date (BP)	Calibrated date (B.C.)
I-8	16	BS-2370	3300±80	3635-3414	1685-1464
H-8	14	BS-2369	6850±200	7926-7511	5976-5561
H-8	12	BS-2054	3410±70	3810-3572	1860-1622
I-8	6	BS -2464	5620±310	6747-6001	4797-4051
H-9	PSB(4)	BS-2417	7530±230	8541-8056	6591-6106
H-9	3	BS-2419	3770±90	4256-3986	2306-4156

dates from Koldihwa, Jhusi (Misra nd: 16)and Lahuradeva (Tewari *et al.* 2003: 55-56, Tewari *et al.* 2005: 40). Two dates (BS-2370 and BS-2054) from this level agree with Chalcolithic dates from other sites of the Vindhyas and the Ganga Valley. It may be mentioned that there is a sharp slope in the layers at site and in the northern and eastern area of the trenches these are considerably thin. Moreover, site was disturbed during the Chalcolithic and Iron Age due to deep undercut pits, hence there is possibility of mixing of deposits. This is possibly the reason why we are getting early dates corresponding to the Neloithic culture, from the Chalcolithic phase (BS-2624) and pre-NBPW Iron Age level (BS- 2417 and BS-2419). In the light of these dates the antiquity of the Neolithic culture of the Vindhyas may be traced back to the 7th millennium B.C.

A large number of animal remains were collected from the excavated trenches. All the faunal material was analysed in 2002 at Allahabad and a full report has been submitted for publication (Joglekar 2004). This report is based on the analysis of faunal assemblages belonging from all cultural periods beginning with the Neolithic-Chalcolithic. During the excavation, several archaeological features such as the pits belonging to various cultural periods were encountered. Faunal material collected from these features noticed in Chalcolithic contexts has been examined (TF=814), but not reported in this paper. This paper is based only on faunal material collected from habitation layers.

Material and Methods

While identifying and counting the specimens, the method prescribed by Clason (1972) has been used. Whenever possible, the ancient fragments of a single skeletal element were not treated as separate entities. All methods, both laboratory and subsequent analysis, were as per the protocol of faunal identification established at the

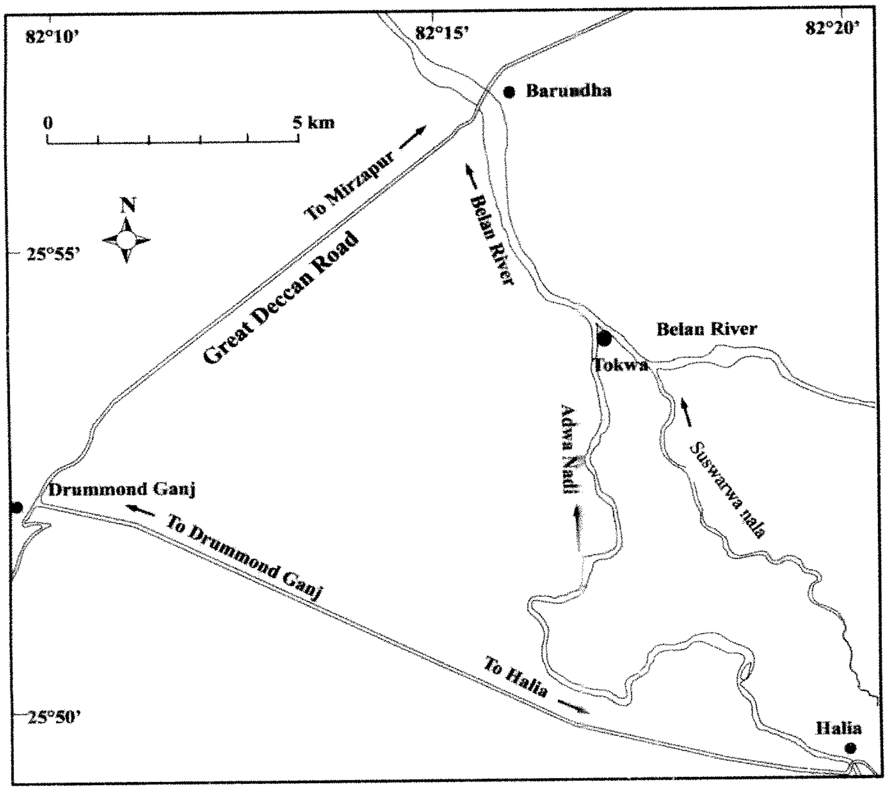

Fig. 1: Map showing the location of Tokwa

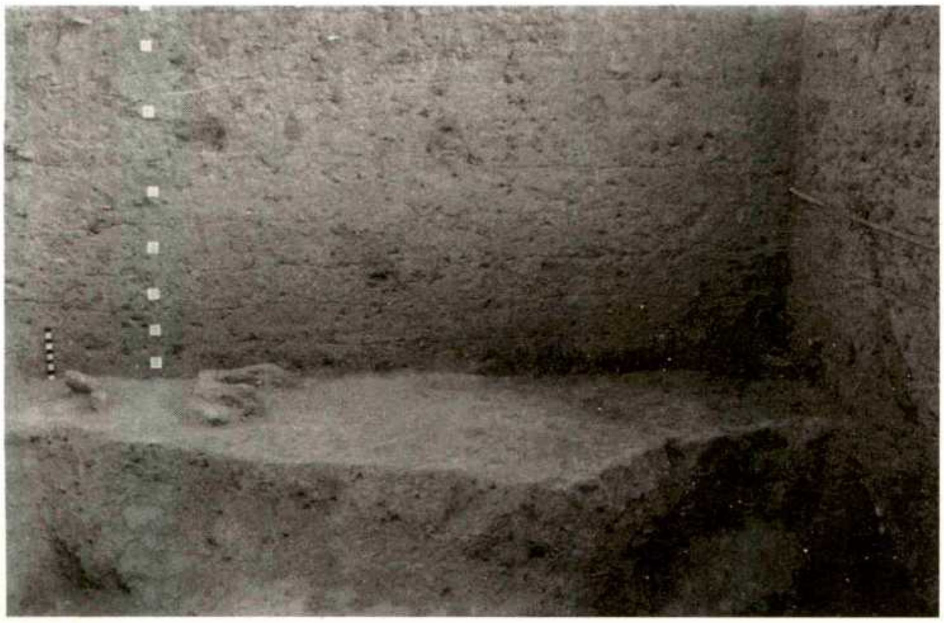

Fig. 2: U-shaped hearth and other artefacts on the floor, Neolithic Period, Tokwa

archaeozoological laboratory at Deccan College since its inception in early 1970s. Since this work was carried out away from the reference collection, several readily available identification keys were used; Schmid (1972) and Hillson (1992) for general identification; Joglekar *et al.* (1994) for finer differentiation between the cattle, buffalo and nilgai; Prummel and Frisch (1986), for identification of bones of sheep and goat; and Pawankar and Thomas (2001) for identification of the blackbuck (*Antilope cervicapra*). For differentiating bones of the gaur from those of cattle and buffalo, keys published by Higham (1975) and Gupta *et al.* (1987) were utilised. For identification of the carnivores (Felidae and Canidae) identification keys developed at the Deccan College (unpublished) were used. For a secure identification, a few skeletal remains were brought to Deccan College and examined with help of the comprehensive collection of modern mammalian skeletons housed in the Archaeozoology Laboratory.

A number of the fragmentary skeletal elements (ribs, vertebrae, carpals and tarsals), could not be identified to the species level. These were grouped into broad classes such as cattle/buffalo (*Bos/Bubalus*) and goat/sheep (*Capra/Ovis*). A large proportion of fragments could not be identified since these lacked any distinguishing markers. These were classified arbitrarily into three groups - large (UF-L), medium (UF-M) and small (UF-S) (Table 2).

Table 2: NISP in Neolithic and Chalcolithic phases at Tokwa

Layer	NISP	UF				TF
		UF-L	UF-M	UF-S	Total UF	
5	136	31	30	8	69	205
6	72	14	16	2	32	104
7	11	0	0	4	4	15
8	11	0	6	2	8	19
9	22	0	0	1	1	23
10	10	0	8	1	9	19
11	14	0	4	0	4	18
12	6	0	2	0	2	8
13	6	0	0	3	3	9
14	7	1	0	1	2	9
15	29	6	14	30	50	79
16	51	0	0	0	0	51
Total	**375**	**52**	**80**	**52**	**184**	**559**

Every bone fragment, wheather identifiable or not, was examined thoroughly for the signatures of pre- and post-depositional factors (like human, carnivore and rodent activities). Intentionally made fractures, cut marks as well as accidental breakage of bones, both in the past and after their recovery from archaeological provenance, were recorded. Marks of carnivore activity were studied in the light of the first author's unpublished observations carried out on carnivores such as hyenas, jackals, dogs and cats. Help was taken from recent experimental studies conducted on modern carnivore eating habits (Sharada and Joglekar 2005-2006). All observations including bone modification were recorded in a computerized coded format. These coded forms were analysed by using DCPARZ – computer software developed at the archaeozoology laboratory by the first author in late 1980s. A standard archaeozoological system of bone identification, faunal data recording and measuring bones (von den Driesch 1976) was followed.

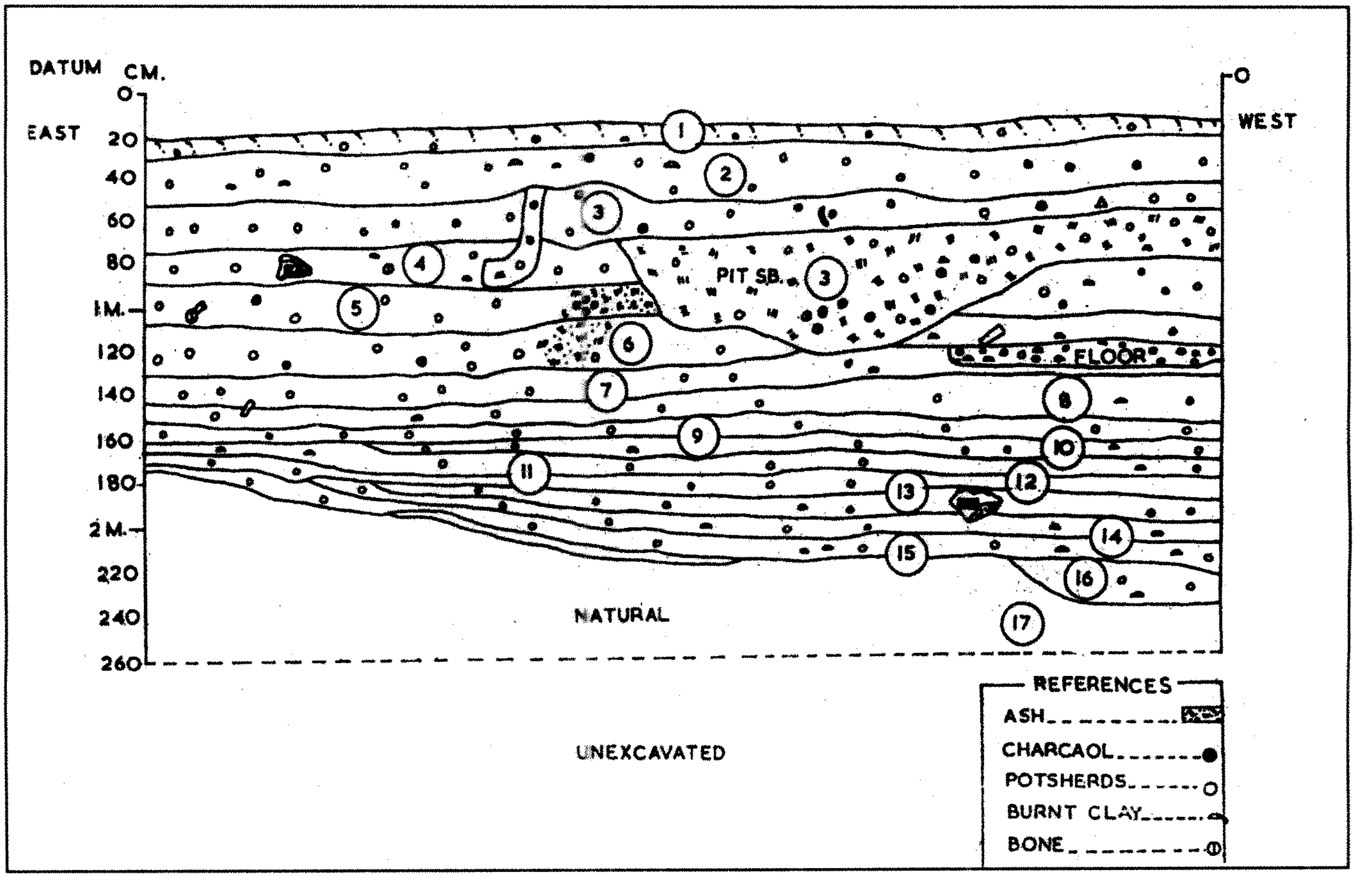

Fig. 3: Section of trench H9 at Tokwa

Faunal Remains of the Neolithic Phase

A total of 235 fragments from the Neolithic context were available for examination of which 156 could be identified (Table 3; Fig. 4). Among the unidentifed fragments, the proportion of small fragments was more than the others. It is interesting to note that many of these were due to intentional cutting and charring of large bovid (domestic cattle/ gaur) skeletal elements.

Faunal material showed the presence of only two domestic mammalian species (cattle and goat), wild mammals, birds, fish and a single molluscan species (Table 3). Domestic mammals formed a major component of the Neolithic faunal assemblage. The proportion of domestic cattle bones is large in all the Neolithic occupational layers (69.2%). Although an intermediate identification category of *Bos/Bubalus* (cattle/buffalo) has been used to classify a number of bone fragments, all perhaps belonged to cattle. It was not possible to identify a single bone fragment as that of buffalo. However, at the same time these skeletal elements (e.g. vertebrae, ribs and long bone splinters) were devoid of any such distinguishing marks that could be used to make a positive identification. Similarly, in the case of sheep/goats, it was not possible to identify a single fragment as that of sheep whereas in one case a positive identification of the goat could be made (Mandible from layer 16: TKW053). However, the proportion of the sheep/goat bones is about 5% of the Neolithic assemblage.

Three rat bones were recovered from layer 14. The general appearance and degree of fossilisation indicated that all three were later intrusions of rats living at the archaeological site. An upper jaw incisor of a bandicoot rat has been found from layer 14 and this fragment is not a later intrusion. It seems that this communal species was living at the same time occupants of layer 14 at Tokwa.

Several species of wild mammals were identified from the Neolithic contexts. These include large bovids- gaur, deer, antelopes, and porcupine. Five bones of the large bovid- gaur (*Bos gaurus*) were recovered from the Neolithic occupational layers. These include only the meat-bearing parts such as humerus, femur and vertebrae. Of these five bones, two fragments recovered from layer 16 are heavily encrusted. The bones of the nilgai (*Boselaphus tragocamelus*) are also five in number and recovered only from layer 15 and layer 16. These include mandible, metapodia, second cervical vertebra and the first phalanx. Only a single fragment of the blackbuck (*Antilope cervicapra*) was recovered from layer 13. It is a proximal portion of metatarsal bone that bears marks of cutting and charring activity.

Skeletal elements of two species of deer – chital (*Axis axis*) and sambar (*Cervus unicolor*) were found from various Neolithic occupational layers. The chital has been found only from layer 9 and layer 15. In layer 15, fragments of scapula and ulna of the chital were recovered, whereas fragments of scapula and humerus were found in layer 15. In both the cases, perhaps these represent a single adult individual. The sambar has been found from only layer 15 and one of the fragments (thoracic vertebra) showed a cut mark. It was not possible to identify two teeth (layer 15) and an antler fragment (layer 16) of the deer whether these belonged to the chital or sambar. A single fragment of porcupine (*Hystrix indica*) pelvic bone (ilium) was found from layer 16. This fragment showed marks of charring and cutting activity.

The birds identified from the Neolithic occupational layers include the jungle fowl (*Gallus gallus*) and the Saras crane (*Grus antigone*), both represented by a single fragment each from layer 15 and layer 9, respectively. The jungle fowl femur (TKW290) belonged to an adult and the size of the bone is smaller than that of the domestic forms. From the fragment of femur of the Saras crane (TKW270) it is clear that it belonged to an adult.

It is clear that the inhabitants of the Neolithic period at Tokwa have used various aquatic resources. Fish have been used as a food resource by inhabitants occupying layers 15 and 13. There were mainly the vertebrae of the small and medium-sized freshwater fish consumed at the site. Four fragments each, of two freshwater fish (*Labio rohita* and *Wallago atta*) were identified from the Neolithic phase. Almost all these fragments were partially charred and broken. One fragment of a maxilla (with teeth) found from layer 12 (TKW058) belonged to a full-grown crocodile. A freshwater bivalve species (*Lamellidens* sp.) was also utilised for food as evidenced from four shell fragments found from layers 11 and 16. All three fragments with heavy encrustation belonged to three individuals.

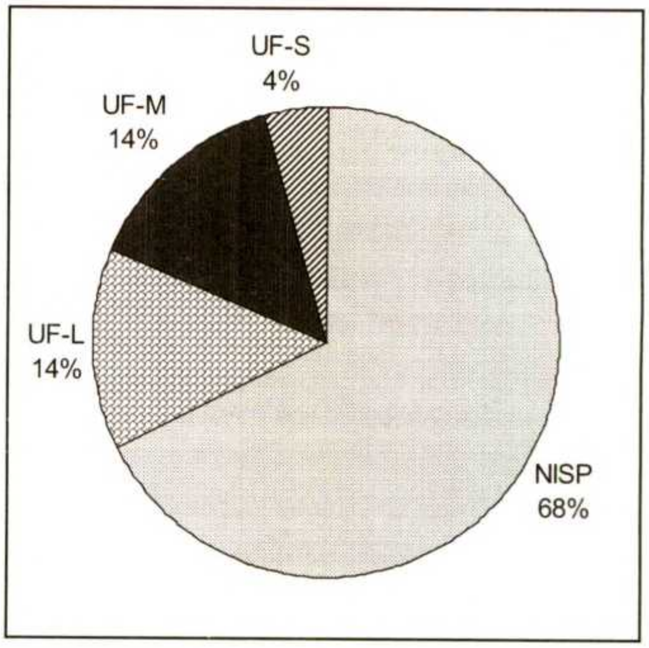

Fig. 4: Neolithic phase: Break-up of unidentified fragments

Several skeletal elements found from Neolithic contexts have evidence of various activities such as

Table 3: Number of identified specimens from the Neolithic occupation layers

Layer	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**Total**	**%**
Bos indicus	10	15	9	13	4	3	0	15	39	108	69.2
Capra hircus	1	2	1	0	0	1	2	0	2	9	5.77
Bos gaurus	0	1	0	0	1	0	1	0	2	5	3.21
Boselaphus tragocamelus	0	0	0	0	0	0	0	3	2	5	3.21
Antilope cervicapra	0	0	0	0	0	1	0	0	0	1	0.54
Axis axis	0	2	0	0	0	0	0	2	1	5	3.21
Cervus unicolor	0	1	0	0	0	0	0	2	0	3	1.92
Cervus/Axis	0	0	0	0	0	0	0	2	1	3	1.92
Hystrix indica	0	0	0	0	0	0	0	0	1	1	0.64
Rattus rattus	0	0	0	0	0	0	3	0	0	3	1.92
Bandicota indica	0	0	0	0	0	0	1	0	0	1	0.64
Gallus gallus	0	0	0	0	0	0	0	1	0	1	0.64
Grus antigone	0	1	0	0	0	0	0	0	0	1	0.64
Crocodylus porosus	0	0	0	0	1	0	0	0	0	1	0.64
Wallago atta	0	0	0	0	0	1	0	0	0	1	0.64
Labeo rohita	0	0	0	0	0	0	0	4	0	4	2.56
Lamellidens sp.	0	0	0	1	0	0	0	0	3	4	2.56
Total	**11**	**22**	**10**	**14**	**6**	**6**	**7**	**29**	**51**	**156**	**100**

charring, cutting and making tools. Fourteen fragments have marks of charring. One of the fragments found from layer 15 was charred to such an extent that it is calcified. Several fragments recovered from all the Neolithic layers have cut marks made by sharp implements. These include bones of cattle and in a few cases of wild animals. For example, the first phalanx of nilgai found from layer 16 shows that it has been cut dorso-ventrally using some sharp blade. A calacaneum of a spotted deer stag found from layer 16 bears oblique cut mark just below the tuber calcis portion. A scapula recovered from layer 15 was cut near the neck region in the case of an adult spotted deer stag. Similarly, an ulna of a spotted deer found from layer 15 bears a sharp cut mark at its proximal end.

A total of nine bone tools were found in the faunal assemblage belonging to the Neolithic layers. Bone tools of a variety of types (points, chisels and scrapers) seem to have been made and used by the Neolithic inhabitants of Tokwa — point (TKW289) made on cattle humerus; and another was a point made on a sheep/goat bone (TKW057). Two tools had charred tips to harden the points, e.g. a tool found from layer 15 (TKW055).

Faunal Remains of the Chalcolithic Phase

A total of 324 faunal elements were recovered from the Chalcolithic occupation layers, of which 219 could be identified. The proportion of the identified specimens in the Chalcolithic occupation layers is 67.60% (Table 4; Fig. 5). Among the unidentified fragments the proportion of the small fragments is much less than those which are medium or large in size. Large fragments were mostly due to intentional breakage of bones, perhaps for extracting marrow, as well as due to the impact of physical factors such as trampling.

Although charring was noticed on several small and medium-sized unidentified fragments, only a single fragment of identified variety in layer 5 was charred. On the other hand, 64 identified fragments out of 219 fragments were with cut marks. A single fragment found from layer 5 was gnawed by a rodent (rat/bandicoot). Though several skeletal fragments showed marks of cutting and exhibited various shapes that resemble tools, only a single bone tool was noticed from layer 7. During the excavations, other bone tools were identified and kept separately (not included in this study).

The overall proportion of domestic mammals is much larger than wild animals. Four wild mammalian species have been represented by only 7 (3.20%) fragments. In this phase, two new domestic species are seen – the domestic pig and the domestic donkey.

The cattle and the buffalo together constituted the major part of the faunal assemblage (88.12%). The proportion of cattle as compared to the buffalo is much more (Table 5). It was possible to identify the buffalo in case of 4 fragments (1.83%). The buffalo bones include only 3 from layer 6 and 1 from layer 5. The skeletal elements are scapulae and the mandible, and all exhibited cut marks. These have been considered to be of domestic variety, based on the size and a qualitative judgement. It is not possible to comment weather these were of hunted animals of small size or these belonged to captive animals in the early stage of domestication.

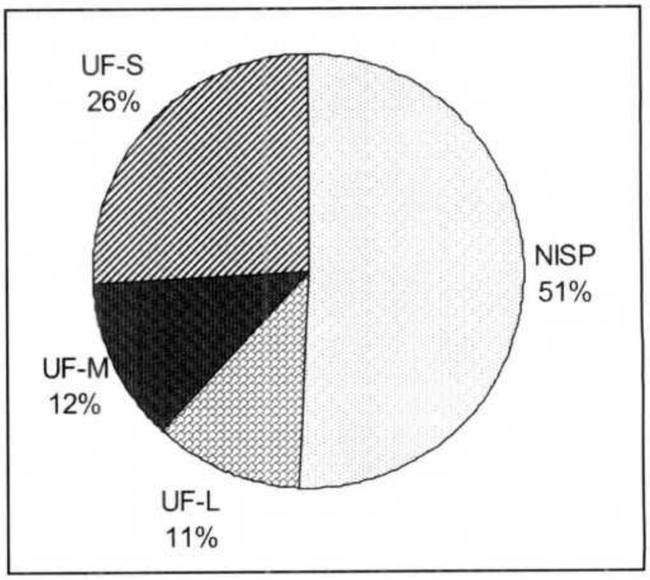

Fig. 5: Chalcolithic phase: Break-up of unidentified fragments

In the Chalcolithic phase the buffalo, domestic pig, sheep and domestic ass were found in addition to the cattle and goat. The spectrum of wild animals is much narrower than the Neolithic phase. Only four wild mammals were found in this phase - gaur, blackbuck, and spotted deer.

The proportion of the sheep/goat is much less as compared to that of cattle and buffalo. Only 17 (7.76 %) fragments of the sheep/goat were recovered from the Chalcolithic layers. In the Neolithic context, not a single fragment of sheep could have been identified with certainty. However, in the Chalcolithic context, one cranial bone fragment found from layer 5 definitely belonged to a sheep. It was possible to identify the goats in four cases – three from layer 5 (frontal bone, pelvic bone and humerus) and 1 from layer 7 (distal end of humerus with a cut mark). In general the overall proportion of the sheep/goat is almost same as that seen in the Neolithic layers.

Only a single fragment of the domestic pig has been recovered from the Chalcolithic layers, though a few more have been found from the pits. A fragment of the domestic pig (proximal end of ulna) recovered from layer 5 (TKW169) belonged to the domestic pig. It seems to have been of small size for an adult pig and perhaps represents a smaller animal.

Table 4: Number of identified specimens in the Chalcolithic occupation layers

Layer	**5**	**6**	**7**	**Total**	**%**
Bos indicus	32	18	4	54	24.65
Bos/Bubalus	85	48	2	135	61.64
*Bubalus bubalis**	1	3	0	4	1.83
Capra hircus	3	0	1	4	1.83
Ovis aries	1	0	0	1	0.46
Capra hircus/Ovis aries	9	0	3	12	5.47
Sus domesticus	1	0	0	1	0.46
Equus asinus	1	0	0	1	0.46
Bos gaurus	0	1	1	2	0.92
Antilope cervicapra	0	2	0	2	0.91
Tetracerus quadricornis	2	0	0	2	0.91
Axis axis	1	0	0	1	0.46
Total	**136**	**72**	**11**	**219**	**100**

* Domestic status not clear

The domestic donkey has been represented by an isolated find of an upper jaw molar (TKW 171). This molar recovered from trench H8 (layer 5) shows marks due to weathering and post-depositional rolling.

Only seven fragments of the wild mammals were recovered from the occupational layers, although several have been found from the pits belonging to the Chalcolithic phase. Two skeletal elements of the gaur recovered from layer 6 and 7 were humerus (TKW172) and a cervical vertebra, respectively. Only two bone fragments of the blackbuck were found from layer 6 – a complete left side of the mandible of an old male that bears a cut mark and a fragment of the left side of ilium that also has a cut mark. From general appearance of these two bones it seems that these represent a single individual. Two fragments of the four-horned antelope were portions of a single tibia of an adult. These charred and cut fragments were recovered from two different areas in trench H8 (layer 5). From the same trench and same layer a single fragment of the spotted deer was recovered. It is a fragment of the distal end of femur of a young stag/doe as the distal epiphysis in this case is in unfused condition.

Bone Measurements

It was possible to record measurements in case of a few bones (Tables 5-10). All the measurements were recorded in mm using a digital calliper (least count 0.01 mm). These bone measurements are useful for comparing the animal population, especially the domestic ones kept at various archaeological sites within a cultural ambience or between sites of different cultures (Joglekar 2000-2001).

It was possible to estimate the height and size of the cattle found at Tokwa based on two select bone measurements – the distal width of the trochlea of the humerus and the medial length of the astragalus. The distal width of the trochlea of the humerus was converted to estimate the fat-free carcass weight (kg) using the factor given by Noddle (1973). The estimates of the fat-free carcass weight of two cattle are 149.6 and 164.3 kg. This range can be compared with estimates available for cattle at other sites such as Neolithic Jhusi (Joglekar 2007) and Chalcolithic Koldhiwa (Chattopadhyaya 1994). The estimates for Koldihwa are derived from the measurements of humerus and astraglaus. The range of fat-free carcass weight of cattle in the Neolithic phase at Jhusi is 135.6-148.0 kg, and of cattle in the Chalcolithic phase at Koldhiwa is 142.1-150.4 kg. From this comparison, it is clear that the cattle at these two sites were more or less of the same size as that of other sites.

The height of the cattle at the withers was estimated using the medial length of the astragalus (Zalkin 1970). The estimates of the height at the withers of cattle present during the Neolithic-Chalcolithic phases at Tokwa reveal that the range is 116- 126 cm. This range of cattle at the withers is comparable to those found at other sites - Neolithic Jhusi (118.5-120.0 cm) and Chalcolithic Koldhiwa (115.1-125.9 cm).

Concluding Remarks

At Tokwa, both in the Neolithic and Chalcolithic phase, keeping cattle was the main focus of animal-based subsistence. Goat was the other domestic animal used in the Neolithic phase, whereas the sheep and domestic pig appeared during the Chalcolithic phase. A few bones of buffalo have been found in the Chalcolithic context; however, their status regarding domestication is not clear. The people at Tokwa were engaged in occasional hunting. The Neolithic inhabitants have used avian as well as aquatic fauna available to them.

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Table 5: Tokwa: measurements of *Bos indicus* scapulae

Reg-No.	**TK214b**	**TKW168**
Trench	H8-D5	H8-E5
Layer	5	5
Maximum length of the articular process	74.18	66.25
Width of the articular process	51.30	46.65
Length of the glenoid cavity	60.00	55.60

Table 6: Tokwa: Humerus Measurements

Reg-No.	**TKW277**	**TKW263**	**TKW285**	**TKW172**
Trench	H8-C3	H8-D1	H9-E7	H8-C4
Layer	16	16	12	6
Species	*Bos indicus*	*Bos indicus*	*B. gaurus*	*B. gaurus*
Maximum proximal width	–	–	–	–
Maximum distal width	70.73	78.08	90.80	96.00

Table 9: Tokwa: measurements of *Bos indicus* calacaneum bones

Reg-No.	**TKW265**	**TKW278**
Trench	H9-B8	H8-E3
Layer	7	9
Maximum Length	130.80	118.00
Maximum Width	38.42	36.00
Maximum Height	51.68	45.00

Table 7: Tokwa: measurements of *Bos indicus* femora

Reg-No.	**TK215a**	**TKW173**	**TKW174**
Trench	H8-D5	H8-C4	H8-C4
Layer	5	6	6
Length of the capitulum	75.00	61.16	61.27
Width of the capitulum	44.40	49.57	44.00
Maximum distal width	–	–	–

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Table 8: Tokwa: measurements *Bos indicus* astragali

Reg. No	**Trench**	**Layer**	**Lateral Length**	**Medial Length**	**Maximum distal width**	**Maximum lateral thickness**	**Maximum medial thickness**
TKW217	H8-D5	5	76.00	68.85	48.53	38.30	39.14
TKW266	H9-B8	7	69.76	63.34	42.25	33.69	35.10
TKW264	H9C10	9	72.73	68.95	46.16	38.92	42.00

Table 10: Tokwa: measurements of mandibles

Reg-No.		**TKW053**	**TKW284**	**TKW059**	**TKW178**	**TKW177**
Trench		H8-C1	H8-B2	H8-B2	H8-C4	H8-C4
Layer		16	16	11	6	6
Species		*Capra hircus*	*B. indicus*	*B. indicus*	*B. indicus*	*A. cervicapra*
p2	Length	—	09.34	—	—	—
	Width	—	07.00	—	—	—
p3	Length	—	18.41	—	—	—
	Width	—	10.10	—	—	—
p4	Length	—	18.22	—	—	06.71
	Width	—	11.57	—	—	04.92
m1	Length	13.64	22.00	—	21.25	09.69
	Width	06.65	14.81	—	15.47	06.85
m2	Length	—	24.45	26.30	26.11	14.64
	Width	—	15.15	15.05	14.10	07.79
m3	Length	—	37.90	—	—	19.44
	Width	—	15.40	—	—	08.47

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Further Excavations at Thandikudi, Tamil Nadu

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Abstract

Thandikudi was excavated for two seasons (2004 and 2006). A study of four Iron Age graves excavated in 2004 has been published earlier. Results of work on the remaining six graves and a cutting in a habitation, are reported here. The ceramics of Thandikudi belong to the pre-Iron Age and Iron Age levels. The pre-Iron Age pottery has some unique shapes and designs, particularly the Black-on-Red ware basins, ring stand and pot, lipped pot of Red ware (or spouted vessels), Black-and-Red ware dish-on-stands and basins (or deep bowls) with raised lugs above the rim (frying pan (*vanali*) like objects). These types are reported for the first time from Tamil Nadu. The occurrence of dolmens, cists and urns points to the convergence of different cultural traits. The etched carnelian, quartz and gold beads and the large amount of iron objects suggest cultural contacts with plains during the Iron Age.

Introduction

The Upper and Lower Palani Hills have been a popular hill resort right from the Colonial Period onwards. British administrators and Christian missionaries were the first to take an initiative in recording the archaeological wealth of this region. The earliest human settlement in this region goes back to pre-Iron Age times. This region was associated with a Sangam Age chieftain named Kodaiporunan (*Purananuru* 205). The poet Peruntalaisattanar narrated that Kodaiporunan performed *velvi*. The performance of *velvi* suggests Brahmanical influence over this region as early as the Sangam Age. Recently, Saranya (2003) undertook an extensive survey and recorded a large number of monuments irrespective their location in remote areas. Some of the important sites here are Kathavumalai, Kottaikal-teri, Idunja-kuli, Perunkanal, Kumarikundu, and Sankarpettu. To understand the cultural wealth of the Palani Hills, Thandikudi (10° 18' 25" N; 77° 38' 40" E), a major site in this region was excavated for two seasons (2004 and 2006). Thandikudi is situated at the height of 1320 m AMSL and about 44 km northeast of Vattalakundu in lower Palani Hills in Kodaikanal taluka of Dindugal district (Fig. 1). Results of the first season's excavation are available (Rajan *et al.* 2005). The findings of the second season's (2006) excavation are reported here. During the second season, both the habitation as well as in the graves were excavated. The habitation mound lies beneath the present village on the left bank of the river *Marudanadi* covering an area of about 20 ha. The total extension of the habitation mound could not be ascertained on the ground due to the nature of the terrain. The existing folk deities, inscriptions and memorial stones located in the habitation area clearly point to long survival of the present settlement. A small area was selected for excavation and two trenches were laid in the habitation area. The first is in the open field locally called *kodakkamantai* on the northern part of the village leading to the Peruganal and the other in the backyard of a residential house.

Burial Complex

The cemetery occupies a large area (more than 40 ha). It extends along the right bank of river *Marudanadi*. This impressive complex consists of about a thousand burials found on undulated rocky terrain dissected with numerous water bodies and channels. Only a few better exposed burials could be counted. More than five hundred burials are hidden and only a part of the cist or capstone are exposed. There could have been many more burials earlier as the cultivators have removed many of them. The intensive coffee and cardamom plantation that has taken place in this region destroyed nearly half of the burial complex. About one third of these burials are in a better state of preservation. Most of the burials are cairn-circles. In a few, the cist is partially exposed due to the removal of the cairn packing by the farmers. The burials are locally known as *pettu*. There are four types of burials — pit burials, urn burials, cist burials and dolmens. Each type has a few sub-types. For instance, the cist burials include simple cist, transepted cist and double cist varieties. Due to limited funds only ten burials were exposed (marked as Meg. I to Meg. X) (Fig. 2). The findings of the first four excavated graves (Meg. I-IV) have been published (Rajan *et al.* 2005).

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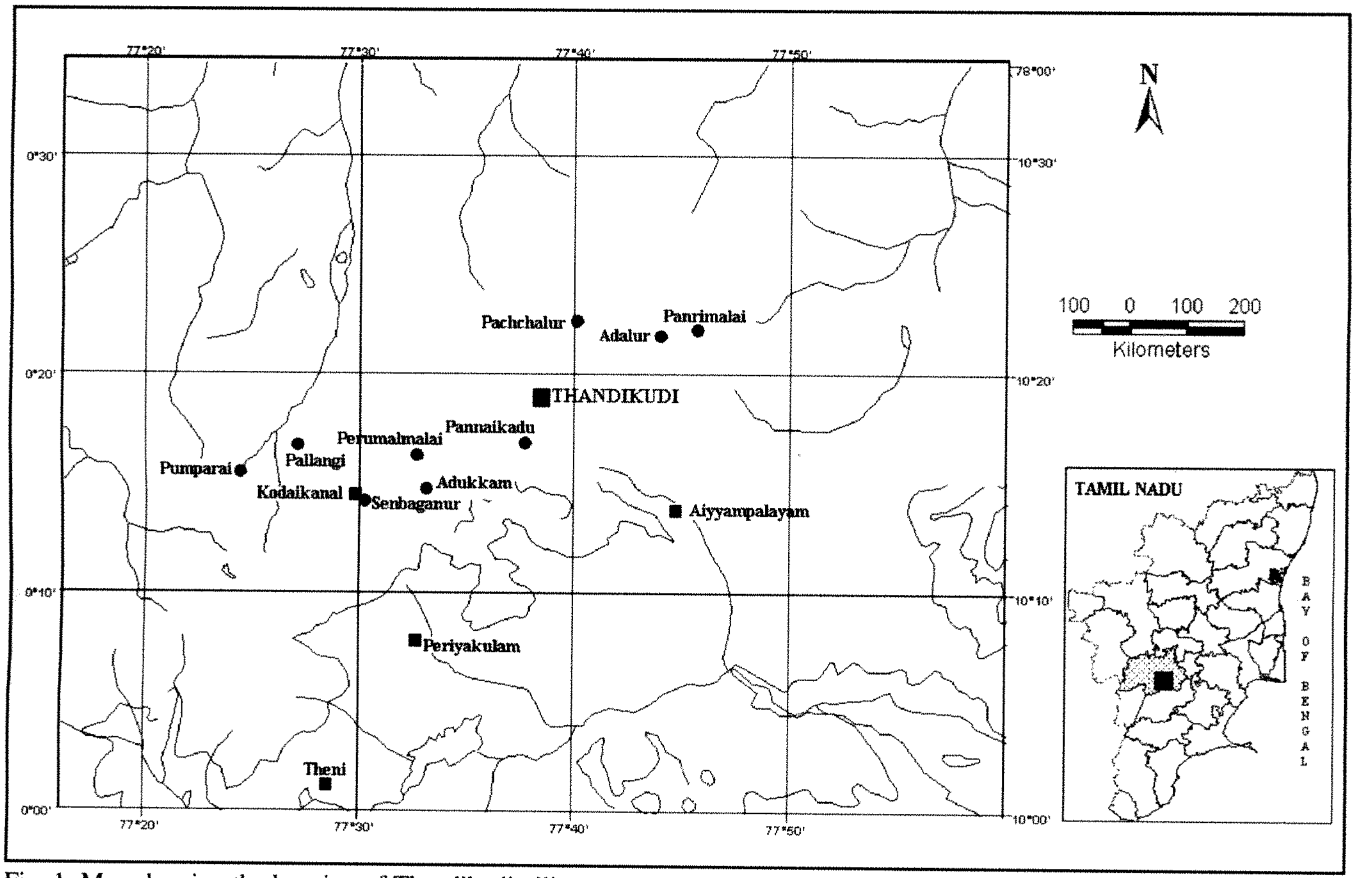


Fig. 1: Map showing the location of Thandikudi village

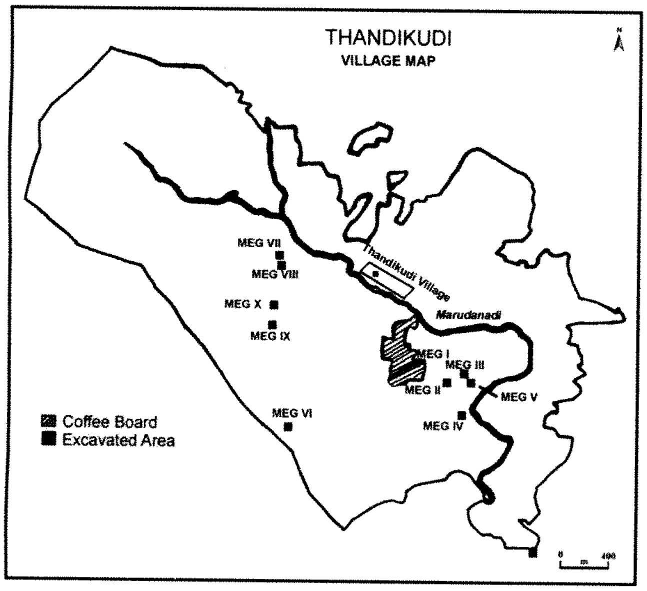


Fig. 2: Map showing the location of excavated graves

Megalith V (Meg. V)

This burial (10° 98' 08" N; 77° 39' 00" E) is located on an elevated flat surface at a distance of 890 m from Thandikudi village with a bearing of 133°. The famous temple of Murugankoil dedicated to Lord Muruga lies at a distance of 1.07 m with a bearing of 109° from Meg. V.

Presently, Meg. V is embedded in the cultivated field. At the time of discovery, only four boulders placed in a circular manner were exposed. The diameter of the circle is 4.80 m. During the excavation, four more circle stones were exposed. A huge capstone measuring 2.40 x 1.35 x 0.33 m covered with 10 cm thick soil is placed perfectly on the cist. After removing the soil around the capstone, a buttress wall appeared in the south and southwest quadrant of the circle. The gap between the capstone and the 180 cm broad circle wall was tightly packed with cairns mixed with red soil. After removal of the capstone, a perfect rectangular cist (Figs. 3-4) with a passage on the east was exposed. The chamber at the base is broad due to the slanting position of the orthostats. A trapeze shaped porthole measuring 0.45 x 0.35 m is visible on the eastern orthostat. On the southern part of the chamber, one stone slab (1.32 x 0.46 x 0.05 m) rested on two small vertical slabs separated by a gap of 67 cm and the whole structure looks like a bench. Nearly 40 carnelian beads, Black-and-Red ware and Black ware sherds were collected from the gap between the two vertical slabs below the bench (Fig. 5). From the gap between the vertical slabs and orthostats, 19 carnelian beads were collected. On the northern part of the chamber, another stone slab (1.46 x 1.02 x 0.10 m) is present at a depth of 1.35 m. This slab is placed on the base slab with 10 cm gap between the two. Under this stone slab and in the northwest corner of the

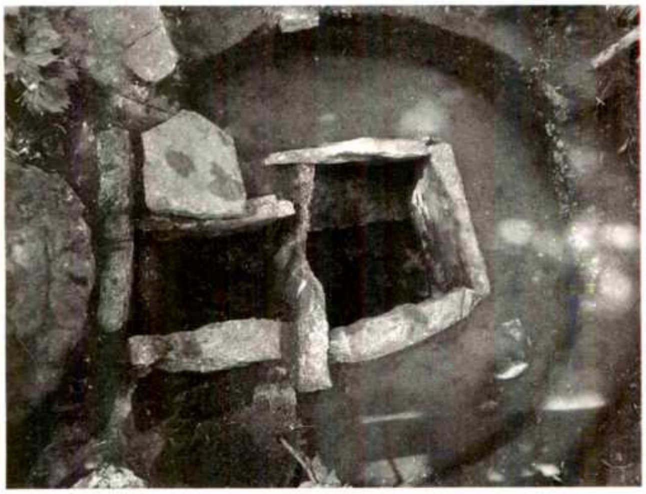
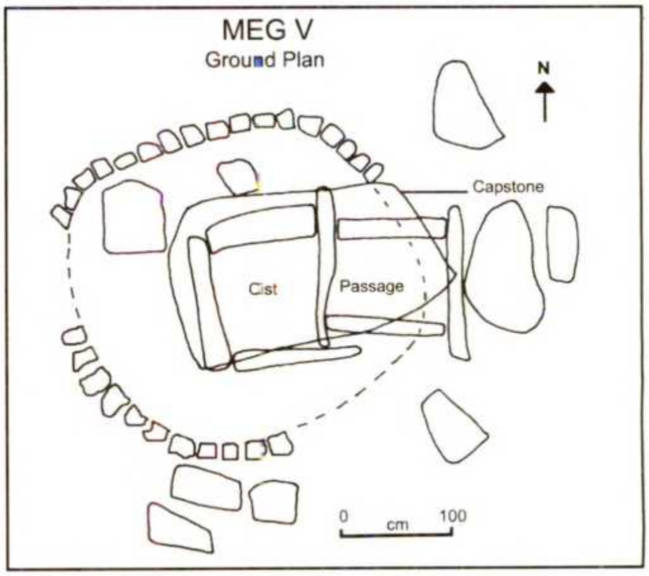


Fig. 3: Meg. V: Cist with passage on the east



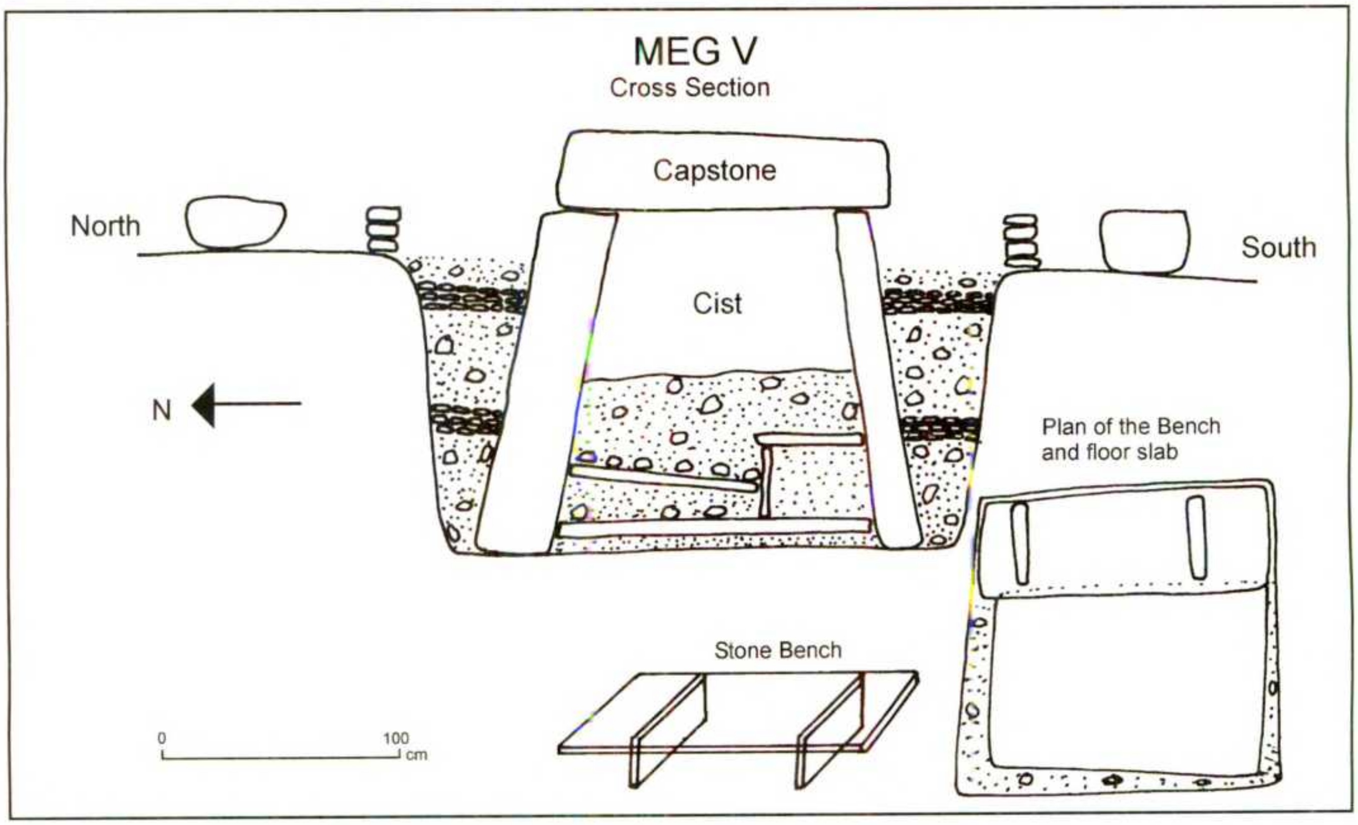


Fig. 4: Meg. V: Ground plan and the cross section

chamber, 93 carnelian beads, Black-and-Red ware, Red ware, and iron pieces were collected. One miniature Black-and-Red ware bowl was recovered from the northeast corner of the chamber. At the centre of the chamber, a broken Black ware ring stand was found. A passage was constructed against the trapeze shaped porthole by placing three slabs to form a box like structure. This passage is filled with stone blocks mixed with soil.

Megalith VI

Meg. VI is located (10° 18' 07" N; 77° 38' 28" E) on a rocky surface at 1385 m AMSL. It lies at a distance of 724 m southwest of Thandikudi village. Meg. VI is locally called as *pettu* and seldom as *arai-manithan veetu* (house of half foot men) or *kutti-cuvar* (dilapidated wall). More than six highly disturbed dolmens within an enclosure wall (max height 1.26 m and breadth 0.60 m) were observed around this Meg. VI. The enclosure wall was almost covered with cairn packing (Fig. 6), and after clearing

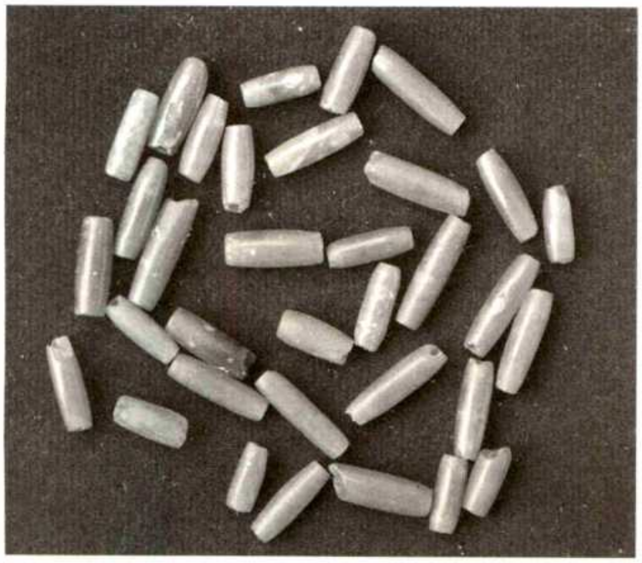


Fig. 5: Meg. V: Carnelian beads collected from the cist

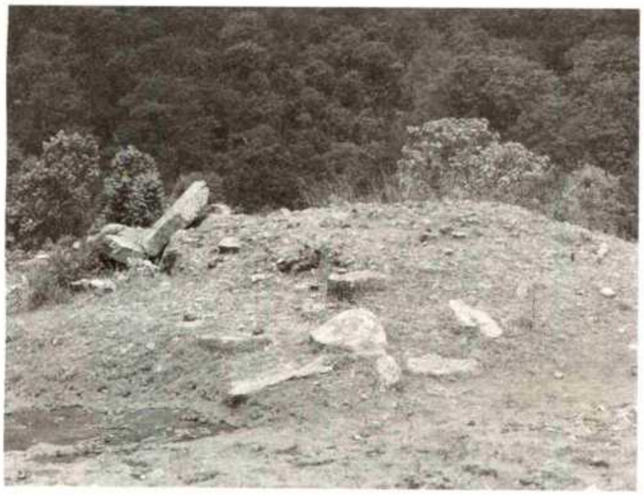


Fig. 6: Meg. VI: Dolmen covered with carin packing

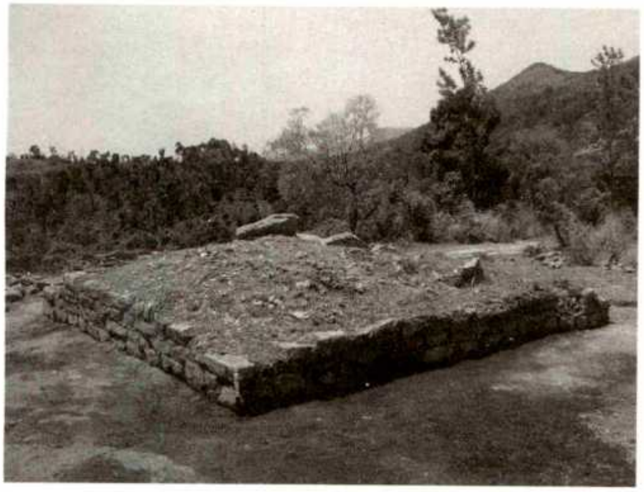


Fig. 7: Meg. VI: Dolmen with the enclosure wall

bushes, stone blocks (average size 100x 60x 20 cm) were visible (Fig. 7). These blocks are of variable size, some rather large, and cleverly adjusted without any trace of mortar. No chisel marks were noticed on these blocks. The layers and stones of different sizes were placed in such a way to avoid vertical cracks and to provide better interlocking. On removal of the overlying cairns, three dolmens (names A, B and C from west to east) were exposed (Fig. 8).

Dolmen A

This dolmen is built of two floor slabs and seven orthostats. The passage has three slabs. The dolmen measures 2.80 x 0.90 m with a working space of 2.50 x 0.70 m. It has a total depth of 90 cm. It has two floor slabs placed from south to north leaving a gap of 30 cm at the back. Around these floor slabs, seven orthostats are present.

Dolmen B

This central dolmen is built of two floor slabs and five orthostats. The passage is built using four slabs. This dolmen measures 2.80 x 1.20 m with a working space of 2.00 x 0.80 m. It has two floor slabs and around these floor slabs, five orthostats were placed.

Dolmen C

The easternmost dolmen (dolmen C) is built using three floor slabs and eight orthostats. The passage built in front is completely disturbed and partially removed. The dolmen measures 2.80 x 1.30 m with working space of 2.50 x 1.00 m. It has a total depth of 90 cm. It has three floor slabs placed from north to south leaving a gap of 30 cm at the back. Around these floor slabs, eight orthostats were placed, one each at the front and back, three on the western side and three on the eastern side. Black-and-Red ware, Black slipped ware pieces and two iron objects were collected from the floor. Of the two iron objects, one is a chisel and the other is perhaps also a chisel. The lower portion of the second chisel (?) is broken. The existing portion measures 7x3 cm with a thickness of 2 mm. The Black slipped ware had white painting executed on the outer side of the rim and on the shoulder portion.

Megalith VII

Megalith VII (10° 18' 19" N; 77° 38' 26" E) dated to the pre-Iron Age is one of the important and the earliest grave so far excavated in this region. The date is based on an material collected from the grave. It is located on an elevated flat surface at the distance of 463 m from Thandikudi village with a bearing of 233°. The famous temple Murugankoil dedicated to Lord Muruga lies at the distance of 13.40 m with a bearing of 27° from Meg. VII. A small rivulet known as *Deva-kattu-odai* flows at around 300 m to the west.

Meg. VII is a stone circle entombing a pit burial. Fifteen boulders have been placed in a circular form with a 5 m diametre. A capstone placed at the centre of the circle is partially exposed (Fig. 9). The grave goods were placed in two rows one above the other in an east-west axis in a rectangular pit (measuring 310 cm east-west and 165 cm north-south) dug into the natural soil (Fig. 10). The pit has a total depth of 160 cm from the surface. A narrow 15 cm deep cutting at the base, filled with fine soil, served as a cushion for the grave goods (Fig. 11). The first layer of grave goods was placed over this fine soil. The grave goods were placed in east-west axis starting from the westernmost point. All 26 pots were placed with their mouths facing east. This phenomenon is also noticed in case of the urn burial (Meg. VIII), exposed near this burial. The lowermost layer consists of 15 pots - urn (1), Red slipped pots (5), Red ware lipped pot (1), Red ware bowls (4), Black-and-Red ware dish-on-stand (or shallow bowl-on-stand) (1), Black-and-Red ware deep bowl (1), Black-on-Red ware basin (1), and Red ware ring stand (1). The top layer consists of 11 pots - Red slipped pots (4), Red ware bowls (2), Black-and-Red ware dish-on-stand (or shallow bowl-on-stand) (1) (Fig. 12), Red ware ring stands (2), Black-on-Red ware pot (1), and Red ware frying pan (*vanali*) (1). In the second row, pots are placed right on the first row.

All grave goods are covered with fine soil upto the mouth of the pit. To demarcate the pit, small stone pieces were placed on the boundary. A capstone made of four pieces, was placed in an east-west orientation covering the entire pit below it. Of these four pieces, the easternmost rectangular flat slab is larger in size (200 x 100 x 19 cm) and covers almost half of the pit. The second capstone (130 x 115 x 12 cm) is placed on the westernmost end. There is a gap of about 46 cm in between these two capstones. This gap is covered with two overlapping slabs. Around the capstone, 12 boulders were placed at ground level in circular form having a diameter of 5 m. On the whole, the stone circle is above the surface and pit burial is below the surface level. Whether there was any cairn packing at the time of disposal of the dead, could not be ascertained. The interesting feature of this pit burial is that the pots are placed in a pit like those found in Neolithic-Chalcolithic graves. The mouths of all the pots face east as seen in the case of Neolithic-Chalcolithic pots. The absence of iron and presence of the Black-on-Red ware is suggestive of its early date. It can be safely placed in the pre-Iron Age level.

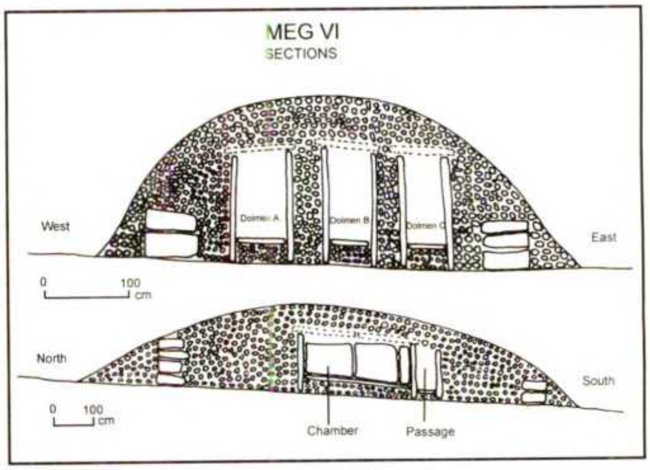


Fig. 8: Meg. VI: Three dolmens

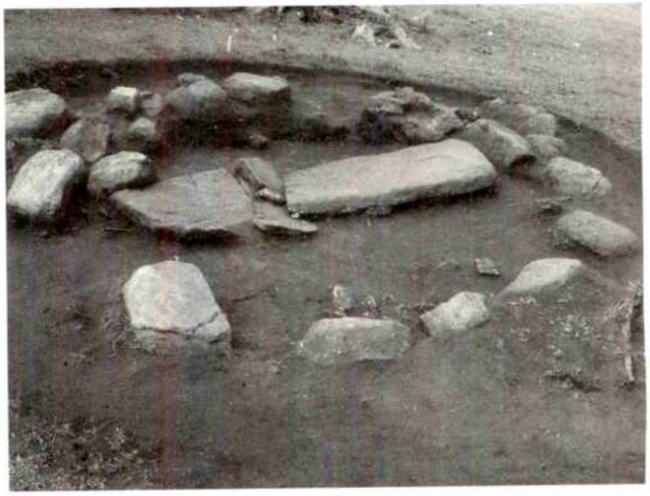


Fig. 9: Meg. VII: Capstone covering a pit burial

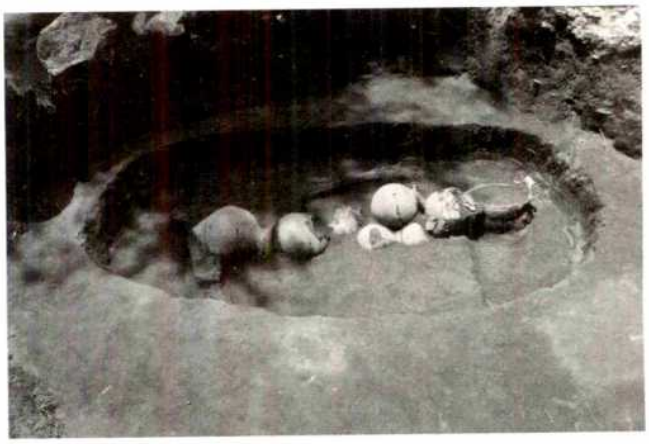


Fig. 10: Meg. VII: Grave goods placed in east-west axis with all pots facing east

Megalith VIII

Meg. VIII (10° 18' 20"N; 77° 38' 26"E) is located on an elevated flat surface at a distance of 477 m from Thandikudi village with bearing of 232°. It is a simple urn buried in a circular pit (diameter180 cm) dug into the natural soil to a depth of 130 cm. A coarse Red ware urn having a wide mouth (maximum diameter 40 cm) is placed at the centre of the pit in a slanting position with mouth facing east. The urn (height 84 cm) has a flaring rim, narrow neck, bulbous body and button-shaped base. This urn was closed with a Red ware pot which is completely crushed due to the weight of the boulder. Around the urn on its southern side, several pots were placed in a systematic manner, all facing east (Fig. 13). Such a phenomenon, with the mouth of all pots facing east, is observed in Meg. VII. The pots contains a beautiful Black-on-Red ware pot, a Red ware pot (Fig. 14), and the ring stand is of Black-on-Red ware (Fig. 15). Such Black-on-Red ware pots were unearthed for the first time in Tamil Nadu. Like Meg. VII this grave also is dated to the pre-Iron Age period.

Megalith IX

Meg. IX is located in a cultivated field locally called Dr. Senthilnathan Estate (10º 18' 14" N; 77º 38' 25" E) at a distance of 582 m (height 1416 m AMSL) from Thandikudi village with a bearing of 225°. At the time of discovery, only a capstone (2.00 x 1.80 m) and a few boulders placed in a circular form were visible under heavy bushes. Meg. IX is a cairn-circle of 21 boulders (diameter 2.60 m) (Fig. 16). On removal it is seen that the front edge of the capstone is perfectly seated on the top edge of the front eastern orthostat. However, at the back, the capstone did not cover the entire cist. After removal of the capstone a perfect cist and a passage on the east were exposed. The chamber is broad and it did not yield any appreciable antiquities. However, two etched button-shaped carnelian beads, two iron coils, a knife and an arrowhead were collected from the floor at adepth on 180 cm. Besides, Black-and-Red ware, Black ware, and Red slipped ware pots, and a ring stand of Black slipped ware were collected. One of the interesting features of this grave is the placement of four quartz pieces each at the four corners of the chamber.

Megalith X

Meg. X (10º 18' 15"N; 77º 38' 25" E) is located in a cultivated field. It lies at the distance of 554 m from Thandikudi village with a bearing 226°. The circle stones and capstones are completely removed by cultivators. At the time of inspection, three orthostats running east to west have been partially exposed. It is presumed that the circle with meagre cairn packing had a diameter of 10 m. After removal of the bushes and the topsoil for about 10 cm, double cists have been exposed (Fig. 17). Such double cists have been exposed in Tamil Nadu for the first time.

The Northern Cist

This east facing cist has a main chamber and a passage. The passage is made with two slabs. The southern orthostat extending into the passage served as the southern slab. The eastern orthostat of the cist formed the western side slab of the passage. The remaining northern and eastern sides were constructed with two more slabs. This passage is filled with stone blocks mixed with soil. On the floor level crushed Black-and-Red ware potsherds along with two Black slipped ware ring stands were collected. This chamber yielded many antiquities (Table 1) - beads of quartz (Fig. 18), carnelian, agate and steatite

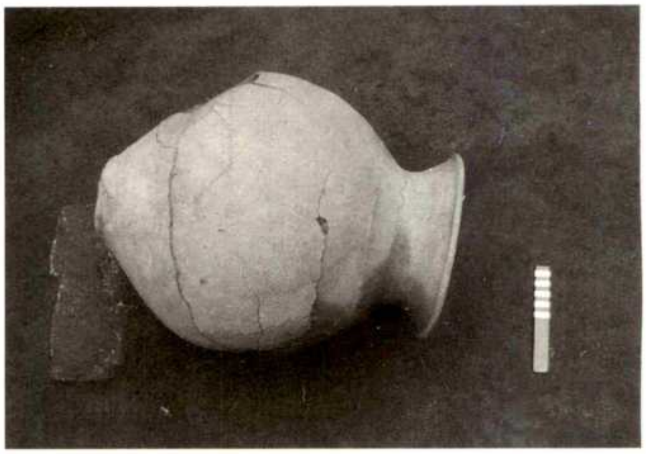


Fig. 11: Meg. VII: Urn with oblique design on the shoulder portion

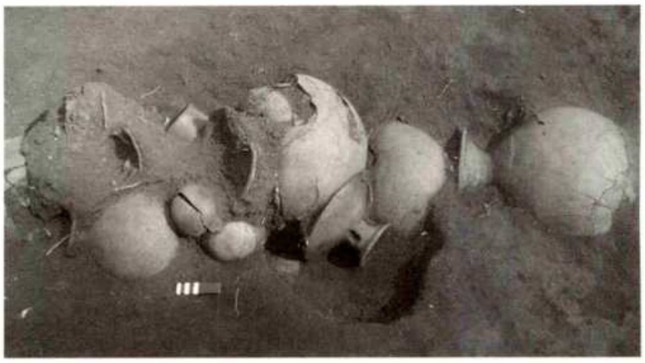


Fig. 12: Meg. VII: Black-and-Red ware dish-on-stand placed as a part of grave goods

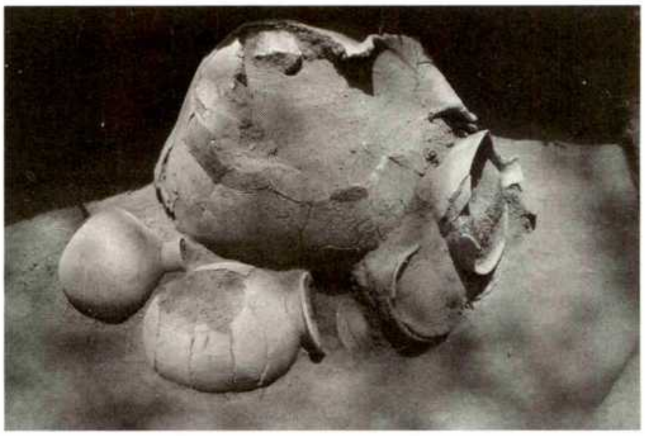


Fig. 13: Meg. VIII: Urn with pots placed around it

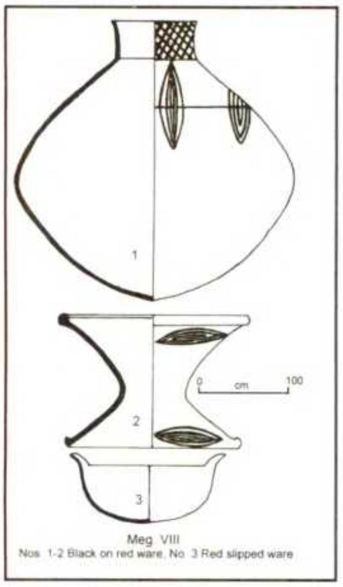


Fig. 14: Meg. VIII: The grave goods

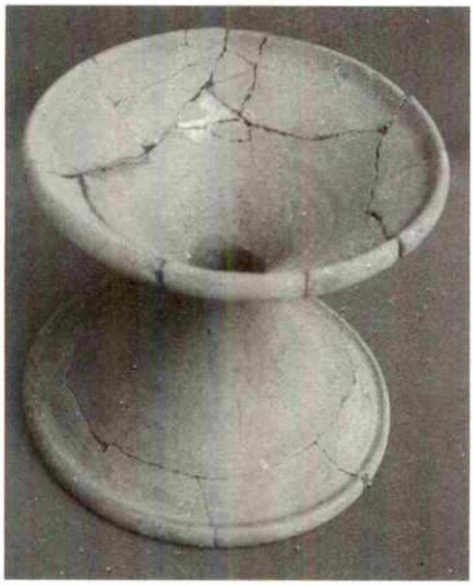


Fig. 15: Meg. VIII: Black-on-Red ware ring stand

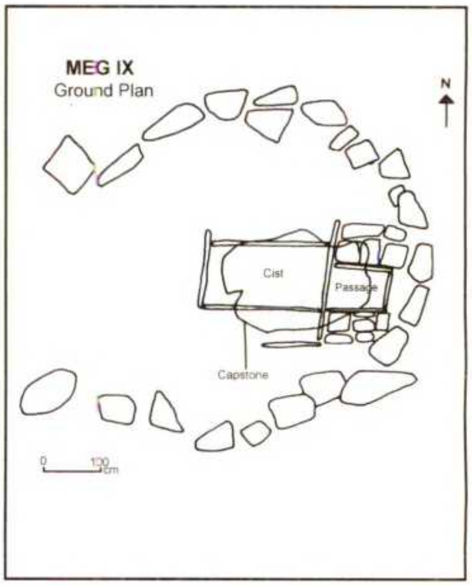


Fig. 16: Meg. IX: Ground plan of the grave

The Southern Cist

This east facing cist has a main chamber and a passage. It did not yield any appreciable antiquities (Table 2) except beads of quartz, carnelian and agate. Besides the beads, a sword was collected from the floor slab near the western orthostat. A bowl of a Black slipped ware was placed on the floor slab against the southern orthostat.

Ceramics

The habitation is totally disturbed due to continuous occupation. It did not yield any appreciable amount of ceramics. The specimens recovered are fragmentary in nature and without any recognisable shape. However, there is an appreciable qualitative difference between the ceramics collected from habitation and that from the graves. This may be due to its utility value. The potsherds from habitation are of routine use whereas those from the graves are specifically manufactured for that particular occasion. Further, the shapes of some of these pots are specific in nature and are manufactured to meet ritual needs. Therefore, one-to-one comparison between the graves and habitation ceramics has not been made.

The ceramics of Thandikudi are of two types. The first one belongs to the pre-Iron Age level and the second to the Iron Age level. The ceramics of pre-Iron Age levels have unique shapes and designs particularly the ones collected from the pit circle and urn burial. These types have seldom been reported from Tamil Nadu. The special shapes and designs also help indirectly to date some of the graves to a pre-Iron Age phase. The remaining pots are of the usual Iron Age types.

Pre-Iron Age

The main ceramics of the pre-Iron Age level comprise. Black-on-Red ware, Black-and-Red ware, Red slipped ware, Black slipped ware and Red ware (Table 3, Figs. 19-21). Of these the Black-and-Red ware, Red slipped ware, Black slipped wares are found in negligible amounts. For instance, only two specimens of a dish-on-stand and a deep bowl were recovered from Meg. VII.

The fabric is of coarse gritty clay, and is homogeneous throughout. The pots have either been fired to a typical red (brick red), or to a black-and-brown, or plain red colour. The surface, in some instances, has more traces of perfunctory burnish. The main forms are lipped pot (spouted vessel) (Fig. 22), bowl (Fig. 23), ring stand, basin like pot with beautiful raised handle on both ends, globular pot, dish-on-stand (Fig. 24), deep bowl (Fig. 25) and long necked bowl with carination. Some of the important forms are discussed below.

A hand-made bowl of brick red colour bears typical marks of finger-tip pressure around the rim. The surface has been roughly burnished, or rather smoothened. This simple form does not commonly occur in Iron Age graves. It occurs in Neolithic-Chalcolithic contexts in Karnataka. For example, Type 4, of Piklihal, common in later Neolithic levels, survives into the Iron Age (Allchin 1960).

The second form is a small bowl with incurved sides, made of similar fabric, but with a distinctive crackle on the surface, resulting from shrinkage during firing. This form too may be compared with Types 5 and Type 9 of Piklihal, occurring in the same horizons as Type 1 (Allchin 1960). However, it is not rare in Black-and-Red ware in the graves, and many specimens are available from

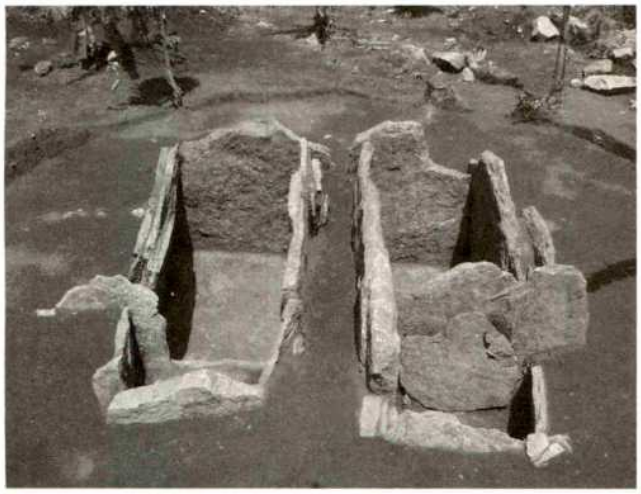


Fig. 17: Meg. X: Double cist with passage facing east

Table 1: Beads collected from the northern chamber of Meg. X

Material	Shape	Total
Carnelian (etched variety)	disc	5
Carnelian (etched variety)	tubular	3
Carnelian	tubular	1
Agate (banded)	tubular	1
Agate	barrel	12
Quartz	rectangular	9
Quartz	crystal (conical base and flat top)	18
Quartz	triangular	3
Quartz	diamond	1
Quartz	miniature	3
Quartz (milky)	circular	127
Steatite (micro)	circular	878
Total		**1061**

Adichanallur, Brahmagiri, Maski, Mayiladumparai, etc. Similar bowls are also found in the Jorwe culture sites of Maharashtra, and at Navdatoli, in comparable horizons.

The third type is a deep bowl with a raised lip on one side, made from similar fabric. This form is rather more distinctive, and comparisons may therefore yield more significant results, than with the simple bowls. It is reported from Brahmagiri from an urn burial (Black-and-Red ware) which may be assigned to a late phase of the Neolithic. Foote discovered a complete specimen at Patapadu. A nearly similar one is reported from Piklihal, in the shape of a short channel-spout, belonging to the final stage of the Neolithic or very early Iron Age. Specimens of both the raised lip and channel spout type occur at Daimabad in phases I and II, respectively. At Navdatoli they occur in a large quantity in periods III C and III D. Another series comes from West Bengal, from Pandu Rajar

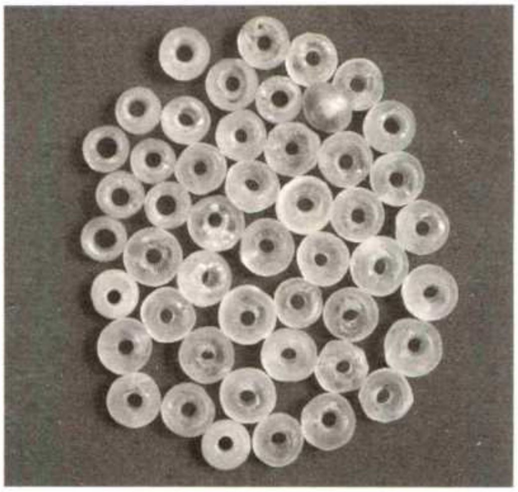


Fig. 18: Meg. X: Quartz beads

Table 2: Beads collected from the southern chamber of Meg. X

Material	Shape	Total
Carnelian (etched variety)	disc	2
Agate	barrel	2
Quartz (milky)	circular	4
Total		**8**

Dhibi and Mahisadal, both from pre-iron levels and immediately after the arrival of the iron.

The fourth form is a roughly made pot with nearly spherical body and raised elongated spout. It is reddish in colour. No other example of this lipped form has been reported in South India, either in the Iron Age or in earlier contexts.

A deep bowl/basin or a frying pan (*vanali*) with raised lugs rising above the rim on two sides is the fifth form. Such bowls are recorded in later and even earlier Neolithic contexts in peninsular India, and have a fairly wide distribution. At Piklihal and Maski, they are found in the Early Neolithic, and at Hallur and Sangankallu in the later Neolithic context.

Another important type is a dish-on-stand on a hollow stand or foot. The stand has three elongated perpendicular slots cut in it, giving the effect of four slender legs, joined at top and base. The fabric is Black-and-Red. This form is quite unusual. Vessels of Red ware with slightly crackled surfaces, plain flaring rims and globular body are typical of those made by hand or on a turntable. These are common forms in the Neolithic-Chalcolithic sites of Karnataka, e.g. Piklihal form Type 28 and 34 (Allchin 1960).

An interesting piece found in our excavations is a Black-on-Red ware pot with short, narrow, straight neck and a globular body. The painting in black colour is

Table 3: Pre-Iron Age ceramics

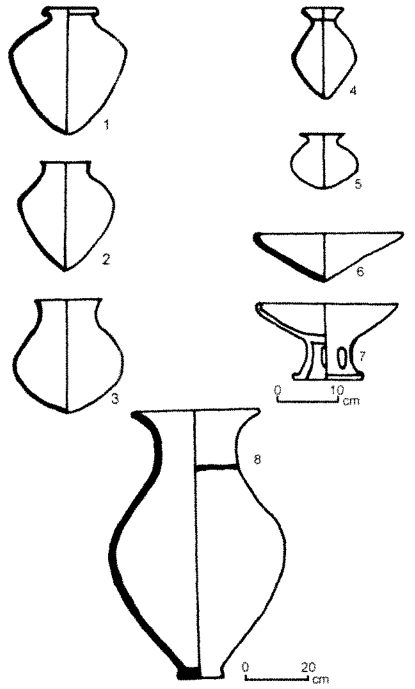
Grave	Nature of ware	Type	Total
Meg. VII	Black-on-Red ware	Basin	1
Meg. VII	Black-on-Red ware	Pot	1
Meg. VII	Red ware	Urn	1
Meg. VII	Red ware	Lipped pot (spouted vessel)	1
Meg. VII	Red ware	Bowl	6
Meg. VII	Red ware	Ring stand	3
Meg. VII	Red ware	basin like frying pan or pot (*vanali*) with a beautiful raised handle on both ends	1
Meg. VII	Red slipped ware	Pot	9
Meg. VII	Black-and-Red ware	Dish-on-stand	2
Meg. VII	Black-and-Red ware	Deep bowl	1
Meg. VIII	Black-on-Red ware	Pot	1
Meg. VIII	Black-on-Red ware	Ring stand	1
Meg. VIII	Black-and-Red ware	Bowl	1
Meg. VIII	Black slipped ware	Miniature bowl	1
Meg. VIII	Black slipped ware	Long necked bowl with carination	1
Meg. VIII	Red ware	Pot	1
Meg. VIII	Red ware	Basin like frying pan or pot (*vanali*) with a beautiful raised handle on both ends	1

executed on the neck and shoulder portion. In the neck portion the criss-cross design is employed whereas on the shoulder portion a leaf-shaped design is executed. Another important specimen is a ring stand of a Black-on-Red ware. The leaf-design is executed on the outer surface close to, but below the ring portion.

The Red ware urn (height 55 cm, mouth diameter 30 cm) of pre-Iron Age level collected from Meg. VII needs a special attention. It has a narrow neck and flared rim. The base ends with a button base. Thumb impressions made at regular intervals with a gap of 4 cm occurs on the shoulder of the urn. The two consecutive thumb impressions are linked with an oblique design. Interestingly all the urns noticed in this part of the region have these designs. The urns noticed in the Iron Age level are larger in size, and were placed on the floor of the chamber of a cist.

Iron Age

Besides, Red ware urns, in the Iron Age, usual forms like bowls, basins, plates, legged jars, miniature pots, miniature bowls, ring stands, small and large pots and lids were found. The urns have a heavily rolled rim, broad shoulder, bulbous body, and button shaped base.



Meg. VII

Nos. 1-2 Red slipped ware, Nos. 3-5 Red ware, Nos. 6-7 Black and red ware, No. 8 Red ware (urn)

Fig. 19: Pot types of the pre-Iron Age level

Chronology

The excavation carried out in the second season yielded substantial evidence which helped in establishing a chronology. Fortunately, all the six graves are of different varieties and each had its own chronological implication both in form as well as in content. The ceramics of Thandikudi collected both from the pre-Iron Age level and the Iron Age level helped us derive a definite chronological framework. Aiyyappan (1940) collected pottery from the graves of the Kodaikanal region through his excavation in 1940. F.R. Allchin (1974: 299-303) studied these finds in 1957 and dated the pre-Iron Age pots to c. 1300-1000 B.C. as they were reported from late Neolithic levels at Piklihal, Maski, Hallur, T. Narashipur and Sanganakallu. Further he suggested that these grave group shares six of eight traits with the pre-iron contexts of South India. Besides the unique types of ceramics, non-availability of iron objects in the graves of Meg. VII and Meg. VIII is crucial for dating. Black-and-Red ware is not found from Meg. I-VI, IX and X. In one group of graves like in pit (Meg. VII), and urn burial (Meg. VIII), iron and carnelian beads are totally absent, Black-and-Red ware is present. This provides a clue to understand the different phases of graves.

Black-on-Red ware pots similar to those found in Meg. VIII have been reported in Chalcolithic levels of

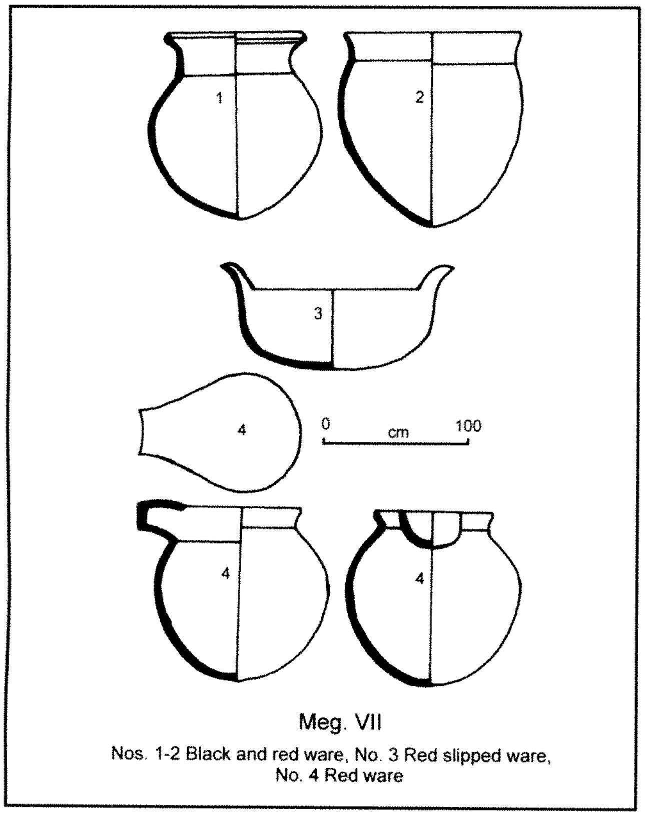

1
2
3
4
0 cm 100
4
4
Meg. VII
Nos. 1-2 Black and red ware, No. 3 Red slipped ware, No. 4 Red ware

Fig. 20: Pot types of the pre-Iron Age level

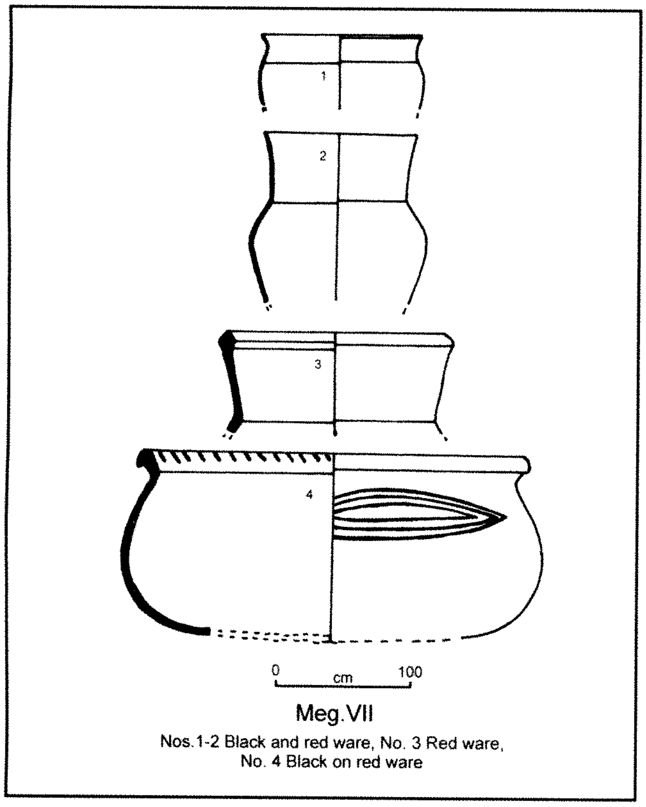

1
2
3
4
0 cm 100
Meg.VII
Nos.1-2 Black and red ware, No. 3 Red ware, No. 4 Black on red ware

Fig. 21: Pot types of the pre-Iron level

Central India and in the Neolithic-Chalcolithic levels of Karnataka and Andhra Pradesh. The excavation at Ramapuram in Kurnool district of Andhra Pradesh have such varieties in the Neolithic-Chalcolithic level. It is to be noted here that among the two graves (Meg. VII and VIII), the pit burial seems to be slightly earlier in date than Meg. VIII. The reason for arriving at this conclusion is the placement of grave goods and the type of urn present. In Meg. VII, the graves are placed in east-west axis with urn at the western end. The urn is placed horizontally with mouth facing east. This urn is comparatively smaller in size. On the other hand in Meg. VIII, the urn is placed in a slanting position with mouth facing east and the grave goods are placed around the urn at the base. Based on the above evidence, the two graves (Meg. VII and VIII) of Thandikudi may be safely assigned to the pre-Iron Age level dating between 1500 - 1000 B.C., and the remaining eight graves could be dated to the Iron Age dating between 1000 and 500 B.C.

It is quite interesting to note that the pre-Iron Age graves are located on the highest point of the burial complex just opposite to the habitation mound on the other bank. As the burial complex enlarged over the years, the graves were dug progressively away from the habitation.

The comparative study made on the graves suggests that people buried their dead near to the habitation in an elevated field on the opposite bank of the river Marudanadi, and later they progressively moved along the bank. In total, ten graves have been excavated. These graves could be placed in chronological order based on the content as follows: pit burial (1), urn burial (1), simple cist (4), double cist (1), cist with bench (1), transepted cist (1) and dolmen (1).

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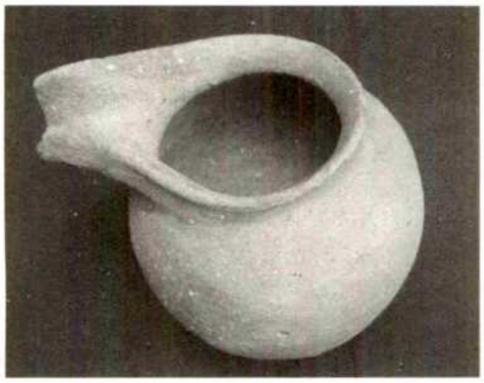

Fig. 22: Red ware lipped (spouted) vessel

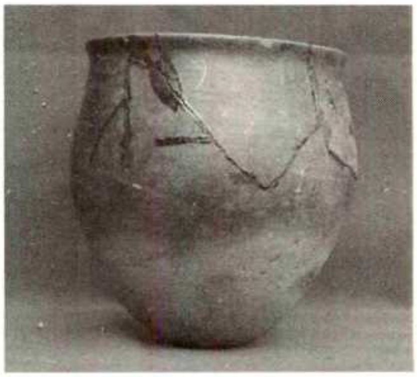

Fig. 23: Black-and-Red ware bowl

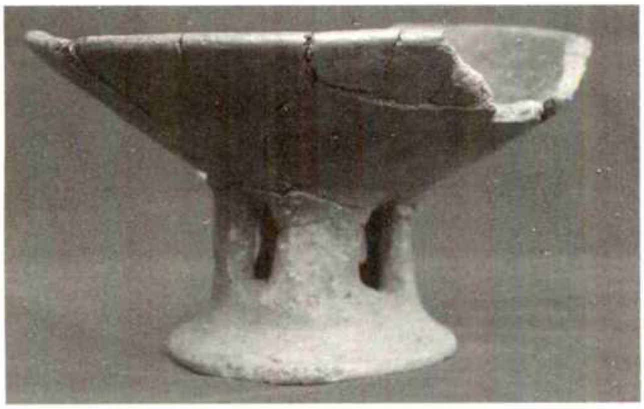

Fig. 24: Black-and-Red dish-on-stand

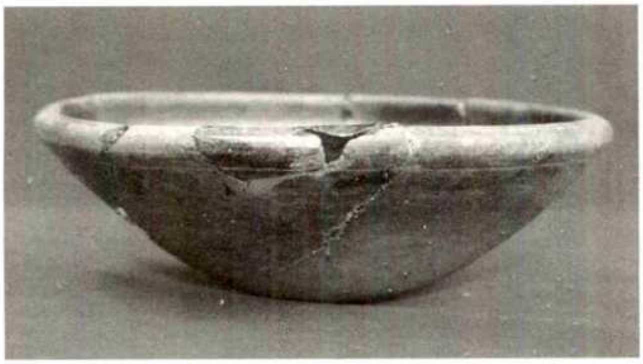

Fig. 25: Black-and-Red deep bowl

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Settlements in Context: Reconnaissance in Western Uttar Pradesh and Haryana

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Abstract

Scholars have known of major palaeochannels that stretch across Haryana and Rajasthan in India and into Cholistan in Pakistan for over 130 years. They are generally believed to be the traces of a substantial glacier fed river (or rivers) that once flowed across these northern plains and this reconstruction is seemingly confirmed by the existence of numerous archaeological sites along these relic water courses. This co-occurrence has led to the suggestion that this river was instrumental in supporting some of the major sites of the Harappan Civilisation, and the drying of this river is believed to have been one of the critical factors in the abandonment of sites, and ultimately the collapse of the Harappan urban system. The relationship between prehistoric settlement and the landscape has major importance for our understanding of prehistoric cultural development in the northwestern plains of India. This preliminary report outlines the first stage of a broader analysis of the relationship between archaeological settlement sites and their geographical and landscape context in western UP and Haryana. These areas have a geographical relationship to the present courses of the perennial Yamuna and Hindon Rivers and of the ephemeral Ghaggar, Sarsuti and Chautang Rivers and associated *nullahs*.

Introduction

Major cultural transformations such as the growth and collapse of civilisations are frequently attributed to climatic and environmental change (e.g. Staubwasser and Weiss 2006). Such inferences are largely drawn from correlations between global climate proxy records and the timing of cultural transformations visible in the archaeological record, but there is little direct evidence to link global scale evidence for climate change to local scale evidence for cultural transformation (Madella and Fuller 2006). Local environmental factors and the way that human societies actually respond to change are also usually overlooked.

For more than 130 years, scholars have known of the existence of a number of major palaeo-channels that stretch across the modern states of Haryana and Rajasthan in India and into Cholistan in Pakistan, and it has been common to associate these with the so-called "lost" Sarasvati River first referred to in Vedic texts (Oldham 1874, 1893; Oldham 1886; Stein 1940; Mughal 1997; Ghose et al. 1979; Yashpal *et al.* 1980). These relic watercourses, which are today known as the Ghaggar, Hakra, Naiwal, Sarsuti, Markanda, and Chautang Rivers, were first recognized on the ground as wide channels demarcated by sand dunes (Oldham 1874, 1893;Oldham 1886; Stein 1940), but more recently their courses have been reconstructed on the basis of satellite imagery (Ghose *et al.* 1979; Yashpal *et al.* 1980). Much debate and speculation surrounds these palaeochannels, primarily because they are generally believed to be the traces of a substantial glacier fed river (or rivers) that once flowed south, southwest and west across the plains of the Punjab and Haryana, thence west and southwest across Rajasthan, southwest to Cholistan, and in some reconstructions onwards to the south to flow into the Rann of Kutch (Oldham 1874, 1893; Oldham 1886; Yashpal *et al.* 1980; Lal 2002). The viability of this reconstruction is seemingly confirmed by the existence of a large number of archaeological sites along these relic water courses, which has also led to the proposition that this river was instrumental in supporting some of the major sites of the predominantly riverine Harappan Civilisation (Gupta 1989, 2001; Mughal 1997; Kenoyer 1998; Possehl 1999, 2002; Valdiya 2002; Lal 2002; Lal *et al.* 2003). Following this

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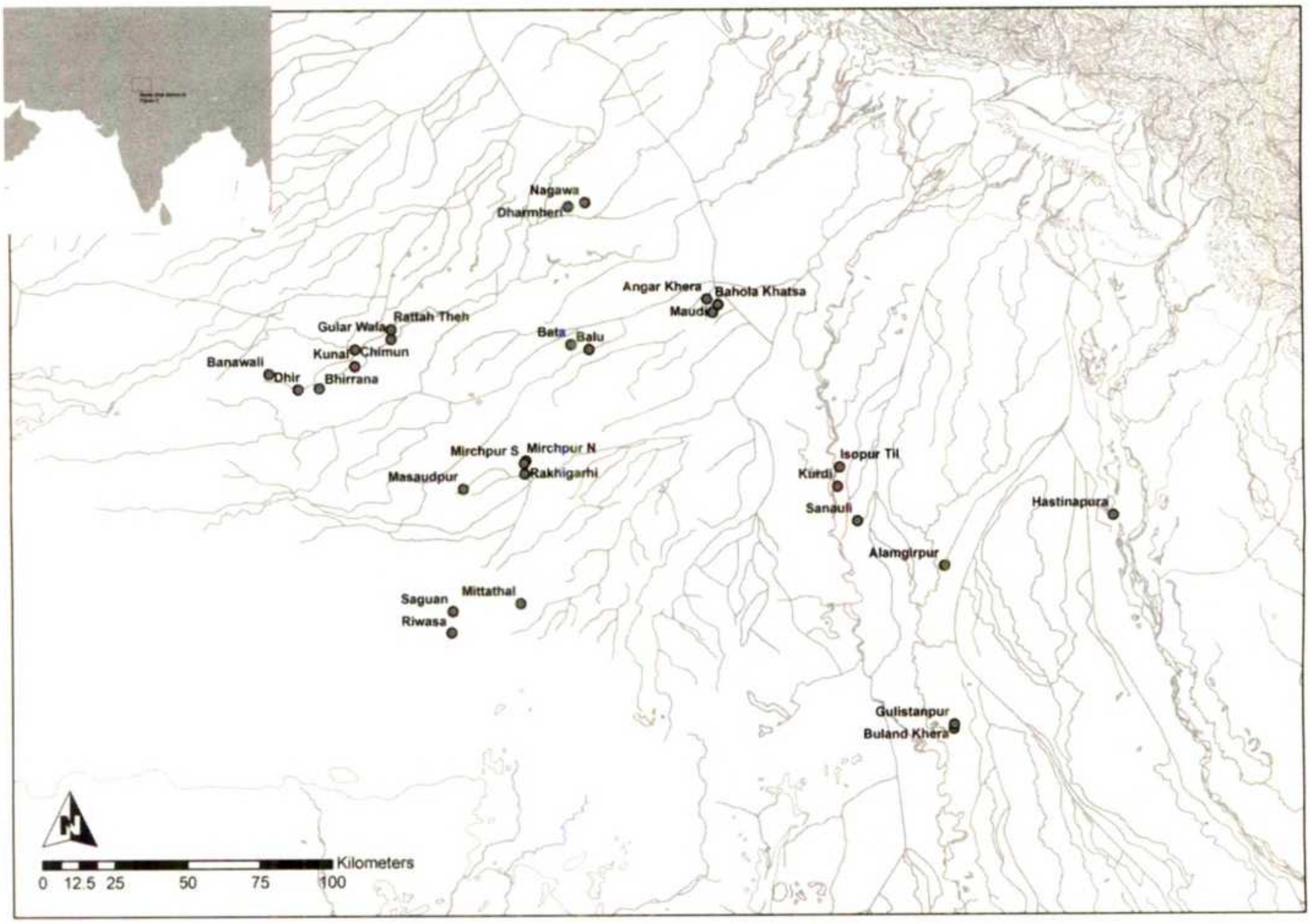

Fig. 1: Map showing the location of the study area in northwest India and the location of the sites visited during the reconnaissance

line of argument, the drying up of this river is thus believed to have been one of the critical factors in the abandonment of sites in Rajasthan and areas of Cholistan, and ultimately the collapse of the Harappan urban system (Stein 1942; Gupta 2001; Mughal 1997; Valdiya 2002; Lal 2002; Lal *et al.* 2003). The specific reasons behind the disappearance of the river are however unclear, but the prevailing opinion is that it was a result of a combination of tectonic activity and river capture, with the latter case seeing both the Yamuna and the Sutlej Rivers shifting to their courses at least once but potentially several times (Lambrick 1964; Wadia 1966; Wilhelmy 1969; Ghose *et al.* 1979; Yashpal *et al.* 1980;Gupta 1996; Mughal 1997; Sahai 1999; Thussu 1999; Malik *et al.* 1999; Gupta 2001; Possehl 2002; Valdiya 2002; Lal 2002; Lal *et al.* 2003).

Perhaps the key factor is that despite extensive debate, as yet we have no precise dates for when these channels last carried perennial water, which has been noted previously (Bisht 2002; Chakrabarti 2008). In fact, it is the dating of the abandonment of archaeological sites such as Kalibangan that is typically used to date the drying of the river (Lal 2002; Lal *et al.* 2003). If we are to understand the geographical context and the human settlement systems that existed in this region, it is essential to establish the chronological and temporal relationships between archaeological settlements and their geographical and landscape contexts. For this, precise dating of the flow and cessation of perennial water in these river channels is critical and this must be combined with careful dating of the occupation and abandonment of archaeological sites in this region. Without this, virtually all of the discussion about the timing of the drying of these rivers and the relationship that this had to settled communities living along them is at best well argued speculation.

Palaeoclimate proxy studies undertaken on lakes in Rajasthan suggest that the approximate time of the Harappan Civilisation was a period of declining monsoon strength, punctuated by episodes of aridity (see Prasad and Enzel 2006; Enzel *et al.* 1999, 2003, Kajale and Deotare 1997; also Madella and Fuller 2006). However, there is only limited information about past environmental conditions on the plains of NW India (Bhatia and Singh 1988; Saini 2003; Saini *et al.* 2005), particularly the summer and winter rainfall patterns during the Holocene.

Table 1 Geographical location* of sites visited during the reconnaissance (UP sites shaded)

S.No.	Site name	Elevation m (asl)	Geo-referenced location				Previous location			
			Easting		Northing		Easting		Northing	
			Deg	Mins	Deg	Mins	Deg	Mins	Deg	Mins
1	Alamgirpur	211	77	29.057	29	00.206	77	30	29	00
2	Angar Khera	240	76	45.125	29	49.403	-	-	-	-
3	Bahola Khatsa	239	76	47.230	29	48.380	76	46	29	48
4	Balu	224	76	23.149	29	40.228	76	22	29	40
5	Banawali	202	75	23.520	29	35.890	75	25	29	36
6	Bata (?1-?4)	223	76	19.794	29	41.098	76	19	29	43
7	Bhirrana	211	75	32.892	29	33.268	75	32	29	32
8	Buland Khera	196	77	30.657	28	30.232	77	30.6	28	30.2
9	Chimun	206	75	39.590	29	40.324	75	40	29	40
10	Dharmheri	233	76	19.417	30	06.493	76	19	30	07
11	Dhir	217	75	28.931	29	33.026	-	-	-	-
12	Gulistanpur	209	77	30.738	28	30.998	77	30	28	30
13	Gular Wala	215	75	46.292	29	42.222	75	46	29	43
14	Hastinapura	219	78	00.497	29	09.395	78	5	29	20
15	Isopur Til	245	77	09.650	29	18.384	77	09	29	18
16	Kunal	211	75	39.509	29	37.260	75	43	29	38
17	Kurdi	232	77	09.258	29	14.820	77	09	29	14
18	Masaudpur	211	75	59.611	29	14.636	76	00	29	14
19	Maudi	224	76	46.189	29	46.923	76	46	29	47
20	Mirchpur (North)	217	76	11.309	29	19.774	76	11	29	18
21	Mirchpur (South)	215	76	10.985	29	19.326	76	11	29	18
22	Mittathal	217	76	10.210	28	53.508	76	11	28	52
23	Nagawa	226	76	22.529	30	07.234	76	23	30	07
24	Rakhigarhi	214	76	11.066	29	17.365	76	07	29	17
25	Rattah Theh	218	75	46.292	29	44.033	75	45	29	44
26	Riwasa/Rewasa	209	75	57.317	28	48.219	-	-	-	-
27	Saguan	210	75	57.603	28	52.135	-	-	-	-
28	Sanauli	221	77	12.950	29	08.465	77	12.95	29	8.46

* All site locations were obtained using a handheld Garmin *etrex* GPS, that has an accuracy of less than 10 m. This is more than suitable for most archaeological applications

A potentially complicating factor is that the data from lakes in Rajasthan is not directly applicable as they are likely to have been subject to different environmental and rainfall systems.

A multidisciplinary collaborative team consisting of researchers from Banaras Hindu University (BHU) (Singh, Singh and Singh), the University of Cambridge (Petrie and French), the University of Oxford (Goudie), Imperial College London (Gupta), the Indian Institute of Technology Kanpur (Sinha), and the Uttar Pradesh State Archaeology Department (Tewari, Yadav and Srivastava), and led by R.N. Singh and C.A. Petrie, carried out a preliminary reconnaissance of a number of Harappan and later period sites in Western Uttar Pradesh (UP) and Haryana (Fig. 1) in April-May 2008. This reconnaissance involved revisiting archaeological sites that were identified in previous surveys (Bhan 1975; Joshi *et al.* 1984; Possehl 1999; Chakrabarti *et al.* 2004-2005, 2006) and recording their precise geographical locations. Opportunistic grab samples of cultural material from the surface of sites were made to evaluate the previously proposed dating and an assessment was also made about their current condition and suitability for further investigation. Furthermore, the immediate landscape hinterlands of sites were investigated in order to characterize their geographical and environmental context and thereby understand the placement of prehistoric settlements in the landscape and their proximity to natural resources etc.

Approach

This reconnaissance was primarily focused on establishing the relationship between archaeological sites and their geographical and landscape context in two primary zones: the area northeast and east of New Delhi in western UP; and the central Haryana Plains, between Hissar and Karnal. These areas were specifically chosen because of their geographical relationship to the present courses of the perennial Yamuna and Hindon Rivers (Districts Meerut, Baghpat, Gautam Buddha Nagar and Ghaziabad, western UP) and of the ephemeral Ghaggar, Sarsuti and Chautang Rivers and associated *nullahs* (Districts Bhiwani, Hissar, Jind and Karnal, Haryana and the southernmost parts of District Patiala, Punjab). The Rewasa Lake playa (District Bhiwanni, Haryana) was also visited (Fig. 1).

To the northeast of Delhi the Yamuna and Hindon Rivers both presently flow in relatively fixed underfed channels: the Yamuna varying between 100-150 m in width, flowing in a channel approximately 1-2 km wide; and the Hindon being between 30-60 m wide and flowing in a channel approximately 1-2 km wide. The present day river discharge does not match the size of either channel, partly because much of the water that would normally flow in these rivers is now siphoned into an extensive canal network that waters the Yamuna/Ganges doab and the plains to the west of the Yamuna. This factor makes it difficult to establish whether there has also been a reduction of discharge from the Himalayas.

The modern hydrology of Haryana is markedly different to that of western UP. Apart from the large canals that draw water from the Yamuna, much of the Haryana Plain is primarily watered by rainfall and the resultant sheet wash that then flows into ephemeral river channels and *nullahs*. The amount of time that this modern hydrological system has been in operation is not at all clear, and there has been much discussion about the possibility that there was a major change in the hydrology of this region in the 2nd millennium B.C. (Fig. 2).

With the desire to assess the relationship between archaeological sites and their geographical setting, particularly the evidence for hydrology, the principal aims of the reconnaissance survey being presented here were as follows:

1. To revisit a number of previously identified archaeological sites that have occupation dated to the Mature Harappan, Late Harappan and/or Painted Grey Ware phases, which are in close proximity to (contemporaneous excavated sites and) perennial and ephemeral river channels;
2. To identify a number of these sites that would be suitable for rescue/test excavation;
3. To assess the immediate and broader landscape and environmental contexts of these sites with special reference to the presence/absence of proximate buried land surfaces, river palaeochannels (that may or may not have been contemporary with the occupation of the site), and dune systems, which have infiltrated large areas of Haryana and western UP at some point in the past.

Each of the project colleagues bring a wide repertoire of different expertise to the project that will develop a number of themes within these main areas of investigation, and all of analyses conducted will overlap and address these main aims.

The 28 archaeological sites were visited during this survey (Table 1). Most of these sites were located in Haryana, and the smaller number of sites in UP are indicated with shading. The site locations shown in the most common archaeological publications are shown in the right hand columns. The site locations established with the use of a handheld GPS during the reconnaissance are shown to the left. The significance of this will be discussed further below.

Geomorphology of the Yamuna/Hindon River System, Western UP

The present Hindon River is a tributary of the Yamuna River. To the east of Baghpat, about 40 km north of New Delhi, the Hindon is incised through very fine white sand and silt deposits up to a depth of about 4 m, set within a 2-3 km wide floodplain. The floodplain/valley edges are defined by irregular but linear arrangements of sand dunes (*c.* 6-8 m high), such as around the village of Pura and the protected Harappan site of Alamgirpur. The floodplain floor of the Hindon appears to be comprised of reworked dune deposits, finely laminated and cross-bedded, rather than alluvial deposits. A farmer spoken to at Pura said that until about 10 years ago the fields to either side of the Hindon had flooded every year during the monsoon. An inspection of the eastern side of the Yamuna River floodplain/valley close to Baghpat (*c.* 30-50 km to the north of Delhi) suggested that a similar dune system was present, which has been much disturbed by quarrying. The Yamuna River itself has a very large and broad meander course that is only weakly incised into the floodplain in this area. When the Yamuna was visited on May 21st, close to the site of Isopur Til, there was no water flowing in the river, and cars were crossing the river using sand bars. This suggests that the modern water flow in the Yamuna is often dramatically affected by the canal systems of Haryana and western UP.

Archaeological Sites in Context, Western UP

In general the archaeological sites visited in western UP were in a relatively good state of preservation. However, several sites are under threat from development, particularly the sites to the south of Noida, which are being encroached upon at a great rate. Rescue archaeology at a number of these sites should be a matter of high priority, or else they are likely to be lost (Fig. 1).

Alamgirpur

(Periods of occupation: Mature and Late Harappan, PGW, Kushan and Medieval)

The Harappan site of Alamgirpur was first discussed by Y.D. Sharma in a brief note published in *IAR* (1958-1959).

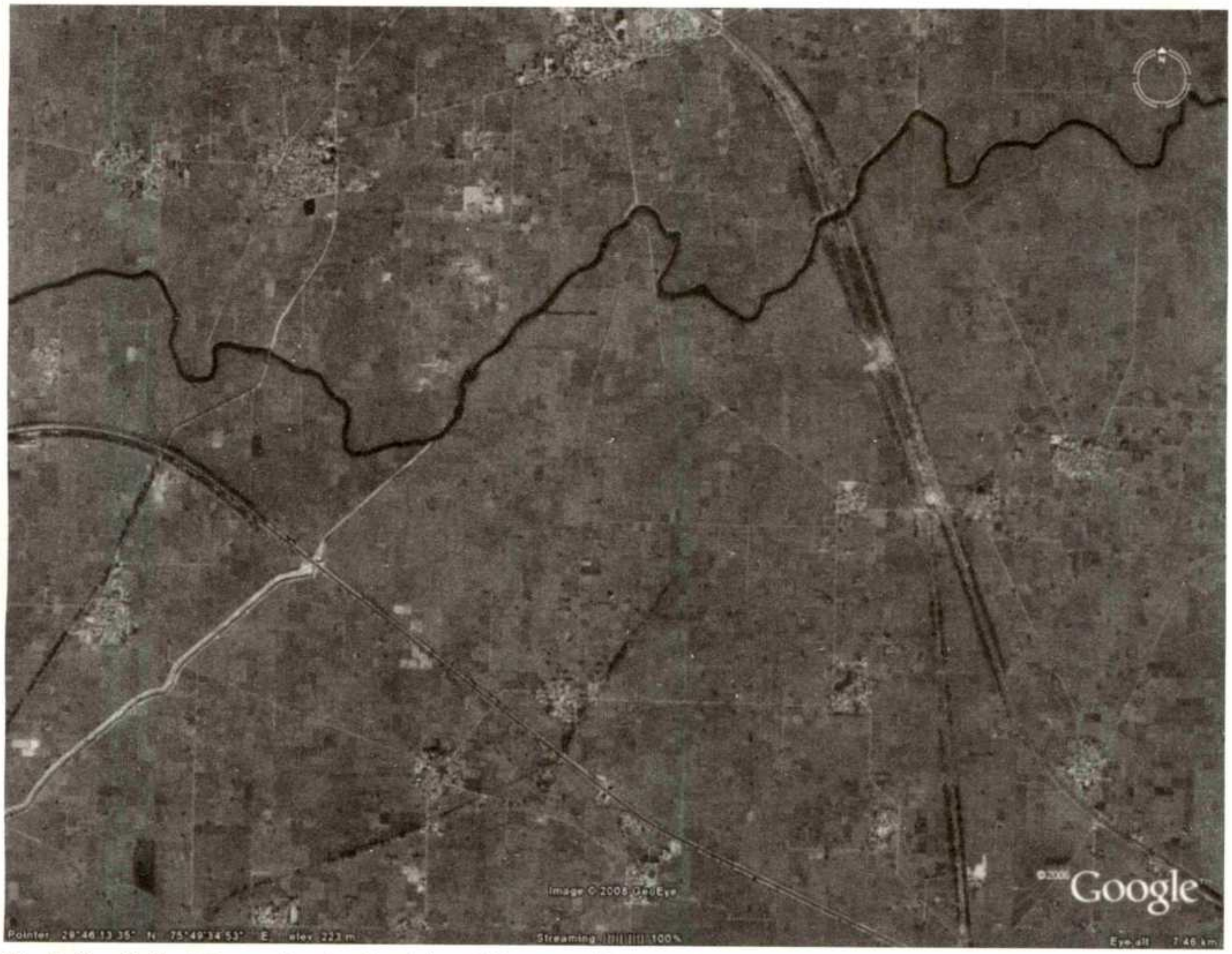

Fig. 2: Google Earth image showing the plains of Haryana with the modern course of the ephemeral Ghaggar running irregularly from right to left, and several modern canals running in straight lines on different alignments

Brief excavations at the site revealed a cultural sequence of four separate periods, including Harappan (Period 1), Painted Grey Ware (Period II), Kushan (Period III) and Medieval (Period IV) phases (IAR 1958-1959; Chakrabarti *et al.* 2004-2005). The initial discussion proposed that there was no continuity between the Harappan and Painted Grey Ware periods and a compact layer existed between the two periods suggesting long exposure to nature (IAR 1958-1959). Alamgirpur is typically considered to be the easternmost Harappan site, but it is perhaps more accurate to describe it as the easternmost excavated Harappan site, as Buland Khera, Gulistanpur, Chandpur and several Harappan sites in Saharanpur District actually lie further east.

New excavations focused on dating the cultural sequence of the site were carried out in May and June 2008 under the direction of R.N. Singh from BHU. The primary aim of this test investigation is to reassess the stratigraphic chronology of the site and to obtain new samples for radiometric dating. These excavations will also provide an opportunity to sample for plant remains and phytoliths, and also to investigate the micromorphology of the occupation deposits and the underling old land surface.

Inspection of the open eroding sections of the site made it is clear that the archaeological deposits (*c.* 3+ m thick) have accumulated on a possibly truncated palaeosol composed of pale yellowish brown silt over a substrate of yellow silt with abundant calcium carbonate concretions and nodules. Some 200 m off-site to the south, a quarry pit revealed at least 4 m depth of aeolian sands that overlie white, laminated, fine river sands.

This stands in stark contrast to the valley fill profile of the plains adjacent to the Hindon where pale brown agricultural topsoil some 80 cm thick overlies at least another 1.5+ m of reddish brown silty clay loam, most probably of alluvial derivation. These land surfaces require further investigation.

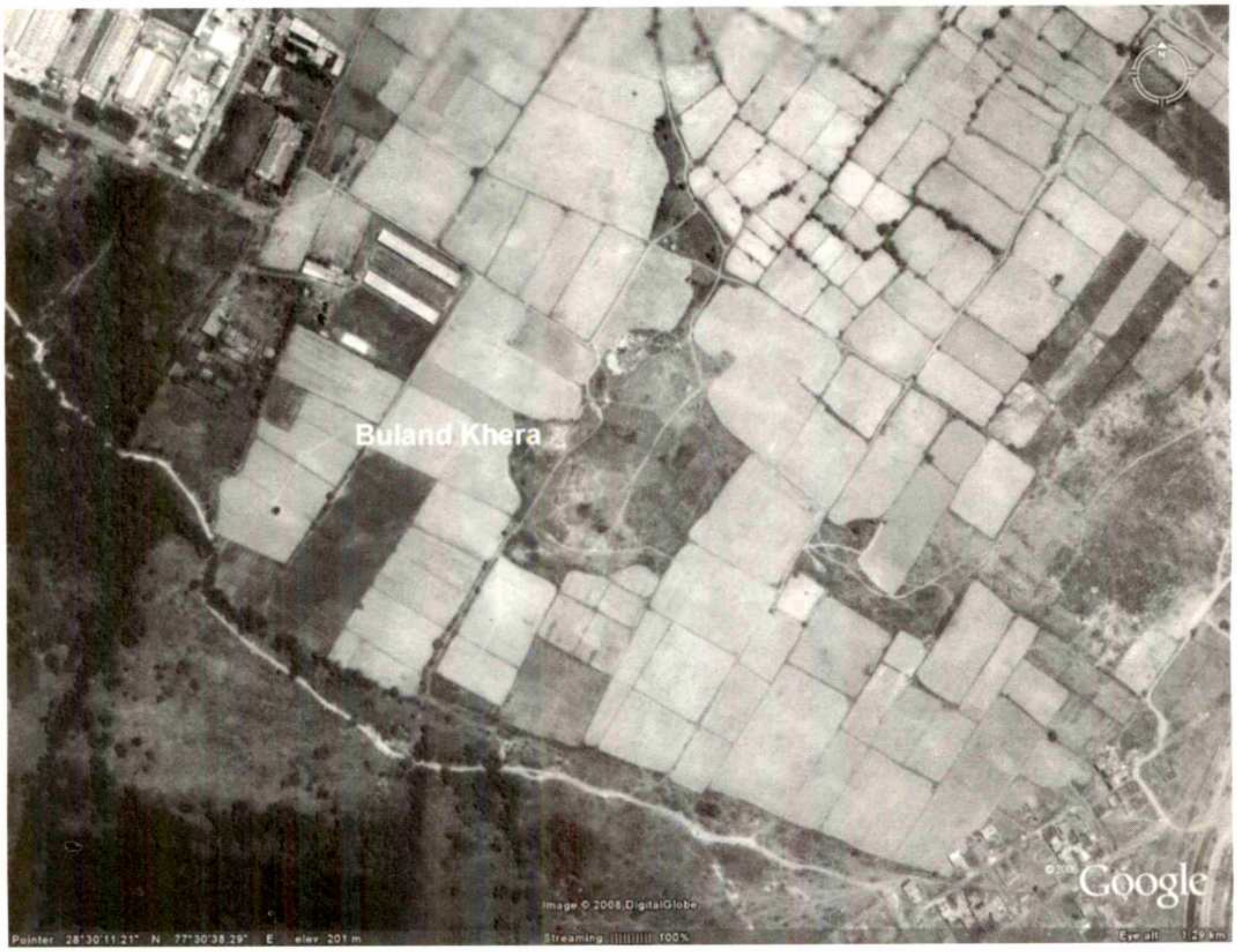
Buland Khera
Image © 2008 DigitalGlobe
© 2008
Google
Pointer 28°30'11.21" N 77°30'38.29" E elev 201 m
Streaming ||||||||| 100%
Eye alt 1.29 km

Fig. 3: Google Earth image showing the site of Buland Khera. There is considerably more construction around the site now than is visible in this image

Buland Khera

(Periods of occupation: Late Harappan and PGW)

The large mound at Buland Khera (Chakrabarti *et al.* 2004-2005) is situated in an area that is relatively untouched by the extensive modern construction that characterizes the areas to the southeast of New Delhi (Fig. 3) It is however under threat, as there are a number of large construction project that are currently underway in this area. The site rises about 5-6 m about the surrounding plain, although it is possible that is was built upon a natural rise. It covers an area of 3-4 ha, and it has been proposed that this was two mounds that now join to form a 'kidney' shaped mound (Chakrabarti *et al.* 2004-2005). A relict water course is visible on the western side. Clearly diagnostic Late Harappan, PGW, Black and Red Ware and Black Slipped Ware ceramics are eroding from the western side of the mound. Excavations focused on dating the cultural sequence of the site were carried out in June 2008 under the direction of R.N. Singh from BHU.

Gulistanpur

(Periods of occupation: Mature and Late Harappan)

The mound known as Gulistanpur (IAR 1963-1964; Joshi *et al.* 1984; Chakrabarti *et al.* 2004-2005) is situated to the south of the main road heading west from Dadri. It is relatively small, approximately 100 x 100 m in size, rising about 4-5 m about the surrounding ground surface. A tall tower stands on the top of the mound, potentially some type of watchtower dating to the British period (Fig. 4). The northwestern part of the site is being encroached on by shops that have been built along the road that bypasses the site, and the southern part of the mound has been built over and is now occupied by a shipping container storage yard (Fig. 5). The image of the site visible on Google Earth shows the shipping container area, but not the row of shops on the north side, suggesting that these structures have been built recently and indicating that the site is in very real danger of being completely destroyed in the near future.

Hastinapura

Although not strictly of interest to the project, the site of Hastinapura was visited. It lies close to the west bank of the Ganges and is a site that is steeped in historical significance. The main mound was originally excavated by Lal (1954-1955), and these investigations included the excavation of a large trench through the northern mound and several other trenches. Most of the mounds are currently covered by a dense growth of trees, but there are a number of modern shrines atop the largest mound. To the west of the site, a large Jain shrine has been constructed, and a large Buddhist/Hindu shrine is currently being built to the northeast of the same mound.

Isopur Til

(Periods of occupation: Late Harappan (?), PGW and Historic period)

The large mound at Isopur Til (Chakrabarti *et al.* 2004-2005) is situated on the east bank of the Yamuna River. It is at least 5-6 ha in area and stands to a height of 20+ m above the surrounding plain. The site is not listed in the Joshi *et al.* (1984) collation of sites in western UP, but there are clear signs of PGW and possible Late Harappan ceramics around the base of the mound. Chakrabarti *et al.* (2004-2005) suggest that black-painted red ware pottery of the Harappan tradition was found at the site.

Kurdi

(Periods of occupation: Late Harappan (?), PGW and Historic period)

The large mound at Kurdi (Chakrabarti *et al.* 2004-2005) is also situated on the east bank of the Yamuna River. It is at least 4-5 ha in area and stands to a height of 20m above the surrounding plain. There are clear signs of PGW and later ceramics around the base of the mound. Chakrabarti *et al.* (2004-2005) suggest that black-painted red ware pottery of the Harappan tradition was found at the site.

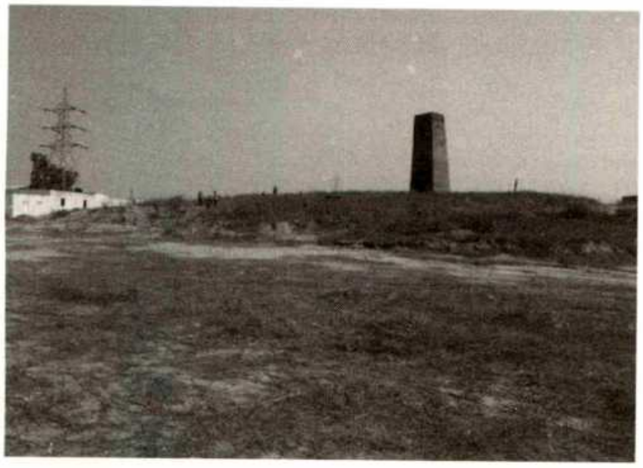

Fig. 4: Photograph of Gulistanpur, showing the 19th century tower on top of the mound (Photo: C.A. Petrie)

Sanauli

(Periods of occupation: Mature and Late Harappan)

The cemetery site of Sanauli was discovered in 2004 and excavated by the Archaeological Survey of India over two seasons. It is situated in the doab region of western UP, and as such is at the easternmost limits of the distribution of Harappan cultural material. The site is of major importance because the graves contained an interesting mix of objects and ceramic vessels including Harappan and OCP vessels and copper objects and weapons suggesting that this is a unique mixture of Copper Hoard, OCP and Harappan cultural material. This has significance for the chronology of these specific cultural phases and also of the relationships that the people interred in this cemetery had with the populations of the Indus and Ganges cultural spheres.

Geomorphology of the Haryana Plains

During the reconnaissance carried out in April 2008, large tracts of the plains of Haryana were traversed. On the ground these appear to be relatively flat plains with low undulations that are barely perceptible. A detailed analysis of a DEM derived from SRTM data or LIDAR imagery would provide a clear indication of the nature of this relief.

At various points this landscape is interrupted by dunes that are either solitary or part of chains of dunes that stretch across large areas. Heading west from Delhi towards Hissar, substantial dunes are first encountered to the northeast of Bhiwani (29° 07.690' N; 76° 09.995' E) and then again at several points on both the north and south sides of the road. Dunes also regularly appear on either side of the main road from Hissar to Sirsa (e.g. 29° 22.749' N; 75° 34.535' E). It is notable that all of these dunes are visible on the British Period 1" to 1 mile maps that were made and revised between 1895 and 1945. In many locations these dunes are being mined today, and a large number of dunes do not appear to act as an impediment to agriculture.

There has been some debate over the age of these dunes. It has been suggested that they were mobile during the Holocene, and acted as one of the contributing factors to the drying of the palaeochannels discussed above (Valdiya 2002; Shinde *et al.* 2008), but there is also a strong possibility that the aeolian sands were mobilized during the most recent period of maximum aridity between 20,000 and 12,500 BP (Courty 1995: 115). Irrespective of the dates of these dunes, they are likely to have been an important geographical factor in the settlement and subsistence strategies used to occupy these plains.

The hydrology of the Haryana plains today is dominated by an extensive canal network that draws water from the Sutlej and Yamuna rivers and supplies it to almost every corner of not only Haryana, but also much of northern Rajasthan as well. Judging from the design of the

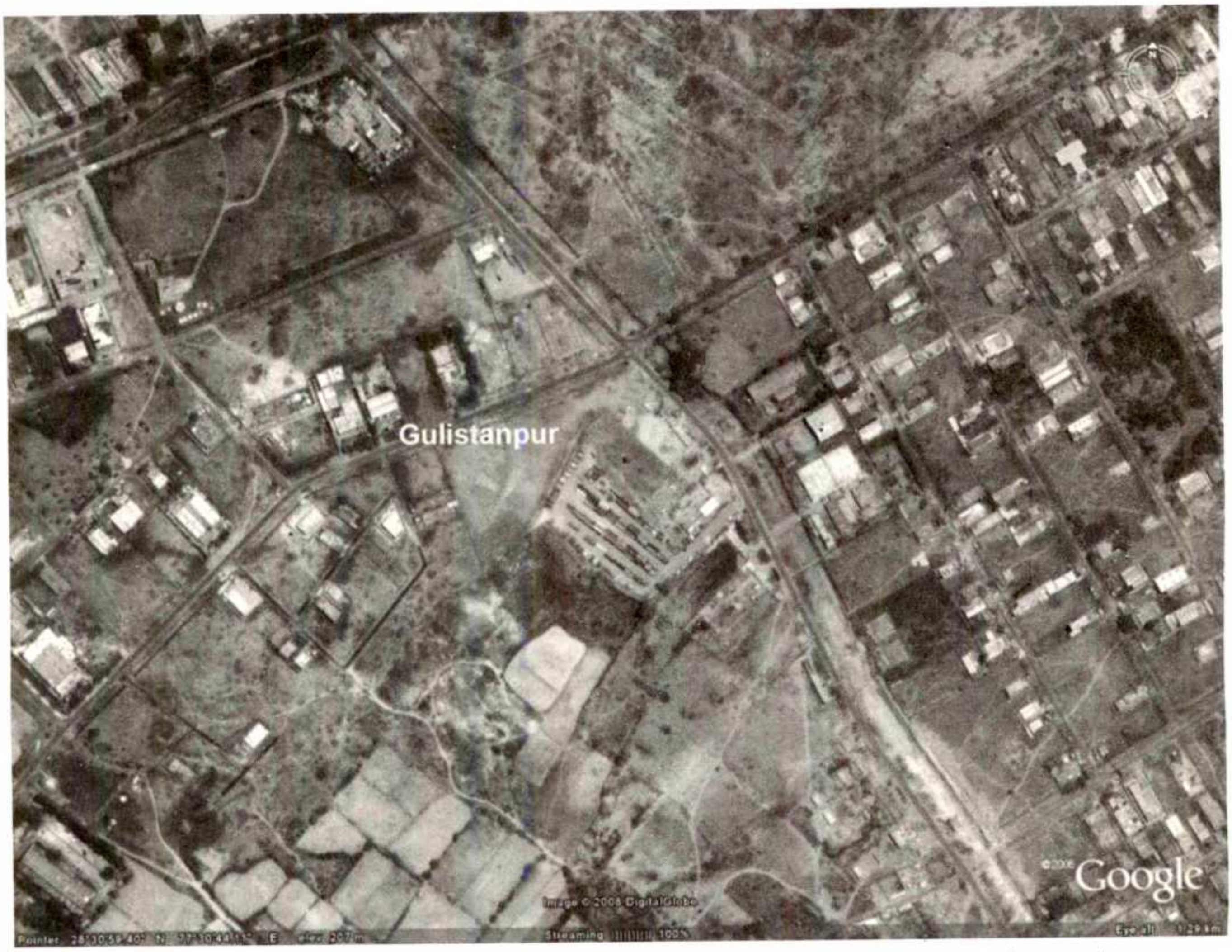

Fig. 5: Google Earth image of Gulistanpur, showing the location of the mound, the tower and the shipping container area on the south-eastern side of the mound

bridges that cross these canals, the canals range in date from the British Period up to the modern day, and their construction techniques vary from unlined channels to channels lined with bricks and/or concrete.

In addition to the complex canal system, there are also a number of ephemeral water courses that only flow during the periods of winter and summer monsoonal rain (Fig. 5). These include the major channels known as the Chautang, Sarsuti, Markanda, and the Ghaggar, and a large number of other smaller channels and nullahs. As noted above, there is considerable debate about the palaeo-hydrology of the Haryana Plains, and it is these emphemeral water courses that are believed to be the modern relicts of palaeo-rivers (Yashpal *et al.* 1980). In general these major ephemeral water courses are deeply incised into the plain, often to a depth of 10-15m and according to height markers inscribed on a bridge over the Ghaggar (Fig. 6) close to Bhagal; water has risen to a height of 20+ feet in recent years. The palaeo-channels through which these modern water courses flow are typically described as being kilometers wide and are almost impossible to see on the ground for much of their course. In recent decades, satellite remote sensing has been the most commonly used means of determining the course of these palaeochannels (Ghose *et al.* 1979; Yashpal *et al.* 1980).

A number of playa lakes are known along the southern margins of this plains region, such as the playas at Dalwada (E 74°32.555' N29°26.235'), Rawatsar (E 74°25.889' N29°16.229') and Riwasa (E 75°57.388' N28°47.405'). None of these lakes has previously been investigated with a view to recovering detailed climate proxy data for the Holocene. Bhatia and Singh (1988) have suggested that there was a lake phase between c. 5363 ±110 and 3640 yrs BP, but this was based on two conventional radiocarbon dates of argillaceous shelly limestone, and Saini *et al.* (2005: 1999) have argued that there is a need to generate rigorous chronological data for the entire lake sequence. The significance of these lakes comes from the fact that they are situated at the edge of the Haryana plains and lie directly on the isohyet boundary

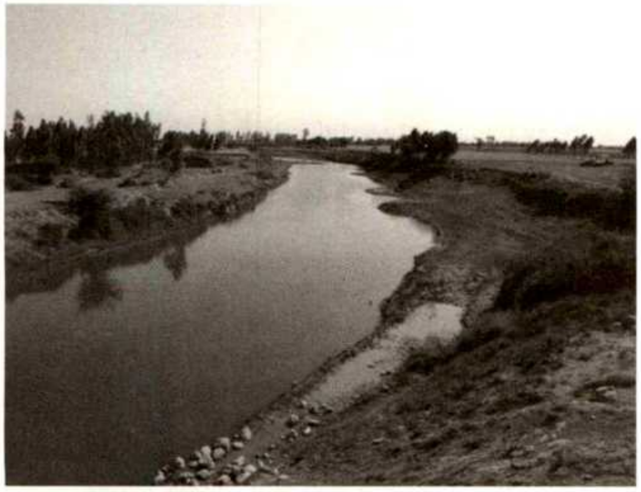

Fig. 6: Photograph of the Ghaggar River in April with slowly moving water (Photo: C.A. Petrie)

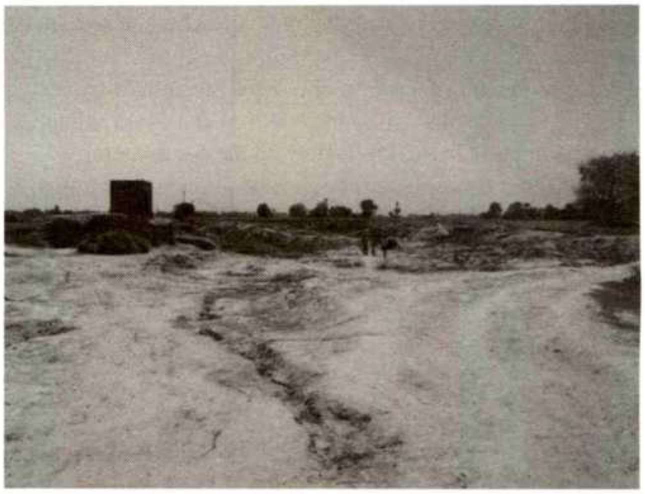

Fig.7: Photograph of Gular Wala showing damage to the site (Photo: C.A. Petrie)

between areas that receive enough rainfall to make dry-farming feasible and areas where agriculture is only possible with irrigation. This suggests that they have the potential to provide very sensitive information about fluctuations in winter and summer monsoonal rainfall, which will be critical for understanding shifts in rainfall patterns during the Holocene.

Archaeological sites in context, Haryana Plains

A number of the unprotected Harappan period sites visited in Haryana were much denuded, flattened and destroyed by village and farm activity – most notably - Chimun and Gular Wala. Dhir has a modern village built on it and cut into one end of an otherwise quite extensive surviving mound. Masaudpur is essentially flattened today, purely by agricultural/ploughing activities (Figs. 7-8).

Angar Khera

(Periods of occupation: Late Harappan and PGW)

The site of Angar Khera is particularly large, stretching at least 200 x 200 m in area and rising to a height of approximately 10 m above the surrounding plain. There is a relatively recent monastery and temple on top of the mound, which would make it difficult to carry out a detailed assessment of the archaeology of the site. However, the exposed sections showed clear indications of occupation dating to the Late Harappan and PGW periods. If size is any indication, the surface ceramics suggest that this would have been an important site during the 2nd and 1st millennia B.C.

Bahola Khatsa

(Periods of occupation: Mature and Late Harappan, and PGW)

The well preserved mound of Bahola (Bhan 1975; Joshi *et al.* 1984), is known locally as Bahola Khatsa, and is located to the south of Bahola village. The mound is relatively low, rising only 1-2 m above the surrounding plain, and extends across on are c. 80 m NS and 100 m EW. It is very flat on its upper surface but does not have clear signs of having been ploughed in recent years. The edges of the mound are however clearly demarcated as a result of ploughing of neighboring fields, which have left the site with a notably sub-rounded shape. The course of a seasonal nullah runs to the east and south of the site, and the proximity of the site to the nullah suggests that this may well be an ancient water course (Fig. 9). This will only be established by geomorphological investigations of the channel and its relationship to the site. Given the very close association between the site and the water course, it could be argued that this site should be test excavated and sampled extensively, and its extent and landscape context be assessed further through geophysical survey and borehole testing.

Balu

(Periods of occupation: Early (Sothi-Siswal), Mature and Late Harappan)

The site of Balu was excavated over an extensive period by the Department of Archaeology at Kurukshetra University (Shukla and Kesarwani 1998; Bhan and Shaffer 1978; Joshi *et al.* 1984). The mound is relatively small in size, stretching c. 200 m EW and 100 m NS, and there is evidence across the surface of the mound for extensive salt encrustation.

Banawali

(Periods of occupation: Early (Sothi-Siswal), Mature and Late Harappan)

The site of Banawali was excavated by the Archaeological Survey of India under the direction of R.S. Bisht between 1974 and 1977 (Bisht 1982; Bhan 1975; Joshi *et al.* 1984).

The main mound is relatively small, stretching across an area of c. 150 m EW x 200 m NS and it is preserved to a maximum height of c.6-8 m above the surrounding plain. The site is situated 1 km to the south of Banawali village, and it is notable that 2 km further to the south there is another mound visible, although it is not clear when this site was occupied (Fig. 10). The site is currently protected by the ASI and there is a site guard living there. As such the mound is very well preserved. It is situated approximately 10 km to the south of the modern course of the Ghaggar River.

Bata (1-4?)

(Periods of occupation: Early (Sothi-Siswal), Mature and Late Harappan)

Several mounds have previously been identified at Bata (Joshi *et al.* 1984; Singh 1981), and one of these mounds was visited. What remains of this mound was located close to Kaithal and to the west of the village of Bata. All that remains of this mound is a small hump of earth that the local farmers claim was raised from the remnants of the archaeological site. This hump is less than 20 x 20m in size and rises to a height of 3 m. The wide scatter of material in the neighboring fields demonstrates that the site was once much larger. It was not clear which of the four known Bata mounds was visited.

Bhirrana

(Periods of occupation: Hakra, Early (Sothi-Siswal), Mature and Late Harappan)

The site of Bhirrana (Joshi *et al.* 1984; IAR 1985-1986) has been excavated by the Archaeological Survey of India between 2003 and 2006 (Rao 2004, 2005, 2006a, 2006b). The mound is relatively low, and extends over 1.5-2 ha, and from indications on the surface of the mound, the ASI excavations were extensive. Much of the significance of the site derives from the fact that it has evidence for Hakra Ware in the earliest levels. There is also Early and Mature Harappan phases of occupation.

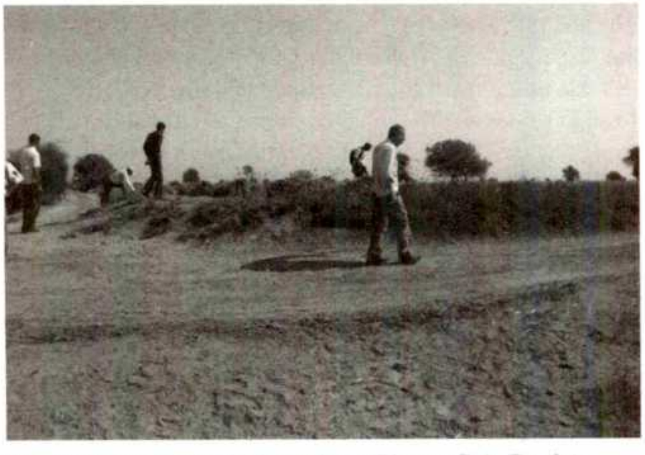

Fig. 8: Photograph of Masaudpur (Photo: C.A. Petrie)

Chimun

(Periods of occupation: Early (Sothi-Siswal), Mature and Late Harappan)

The site of Chimun (Bhan 1975; Joshi *et al.* 1984) lies directly below the modern village of the same name. It is a very large mound rising c. 3-4 m above the plain. It is difficult to estimate the true size of the mound, but it is apparently circular in shape and its dimensions are likely to be something in the order of 200 x 200m. There is a large east-west flowing canal immediately to the north of the modern village, and there are apparently two other mounds to the west that are also referred to as Chimun.

Dharmheri

(Periods of occupation: Mature and Late Harappan)

The site of Dharmheri (Bhan 1975; Joshi *et al.* 1984) lies to the south of the village of the same name. The mound is now covered by houses that appear to have been constructed in the last decade. The site appears to have been c.100 x 100 m in size and only rises to a height of 1m above the surrounding plain. Much of the site has been levelled for the creation of fields. The mound lies approximately 2 km to the north of the dry Ghaggar River bed. However, it is likely that this was not the major source of water for the inhabitants of the site as small nullahs flows very close to the west and south of the site and then into the Ghaggar. This suggests that the larger river is too large and too deeply incised to support sites in this part of the plain. A similar situation was also observed at Nagawa.

Dhir

(Periods of occupation: Historic)

The large mound site of Dhir is at lease 200 x 100 m in area and stands to a height of c. 6-8 m. The mound has extensive, exposed, near vertical sections which could repay cleaning back and sample excavation. This site appears to have been truncated by quarrying activity from the adjacent village. Several houses have also been constructed on the northern end of the mound.

Gular Wala

(Periods of occupation: Early (Sothi-Siswal), Mature and Late Harappan)

The site of Gular Wala (IAR 1980-1981; Joshi *et al.* 1984) situated adjacent to the village of Der, lies about 1.6 km to the north of the village of Gular Wala, has been very badly damaged by modern construction and deliberate earth removal by bulldozer (Fig. 7). As a result, only a *c.* 10 m^2 area survives of what must be assumed to have been the full height of the original mound, *c.* 4m. Adjacent to this pillar of deposit, an area has been quarried to make bricks, and in the process completely removing all traces of the mound. There is a lower (+1 m) area of more extensive mound that survives over an areas *c.* 150 m to the east of

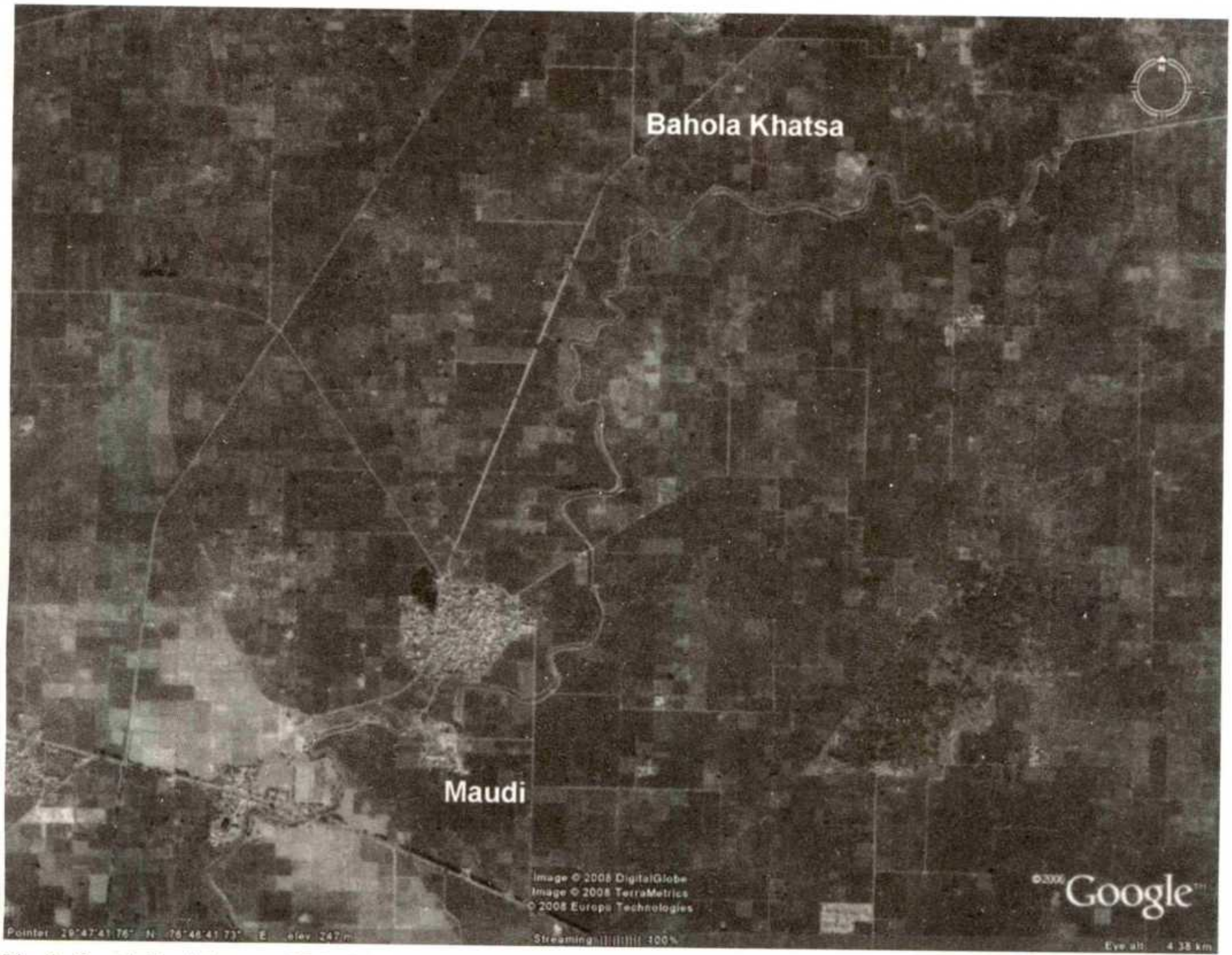
Bahola Khatsa
Maudi
Image © 2008 DigitalGlobe
Image © 2008 TerraMetrics
© 2008 Europa Technologies
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Fig. 9: Google Earth image of Bahola Khatsa and Maudi, showing their proximity to the ephemeral water course

this distant, and this is currently under cultivation, which suggests that these remaining parts of the mound have been ploughed, and are therefore heavily deflated. Substantial pottery (Fig. 11) filled pits were visible in the upright exposed sections and there are clear signs of stratified floor surfaces and mud-brick structures suggesting the high quality stratigraphy is still preserved in at least this part of the site.

This site should be test excavated and sampled extensively, and its extent and landscape context be assessed further through geophysical survey and borehole testing. Certainly the open section in the adjacent quarry contains laminated, micaceous, white fine sands at a depth of about 2 m below the modern ground surface. Again, this suggests the close proximity of former riverine deposits. Moreover the local farmers said that the groundwater table was reached at about 12.2 m adjacent to the site and village, whereas several hundred metres away it was at a depth of at least 28 m, indicating that there may well be a natural aquifer or buried palaeo-channel adjacent to the site.

Kunal

(Periods of occupation: Early (Hakra and Sothi/Siswal) and Mature Harappan, and PGW)

The site of Kunal was excavated by the Haryana State Archaeology Department (Khatri and Acharya 1995; Joshi *et al.* 1984; IAR 1985-1986) and is now protected, with an onsite guard and perimetre fence. The excavated trenches have not been backfilled, and areas of standing mudbrick architecture, pits, in situ storage vessels and other indications of occupation are readily visible. The excavator's sherd yard is also visible to the south of the site.

Masaudpur

(Periods of occupation: Mature and Late Harappan)

The site at Masaudpur (IAR 1980-1981; Joshi *et al.* 1984) is situated approximately 1km to the north of Masaudpur village, and lies to the west of Rakhigarhi. The mound has been flattened by agricultural activity, but appears to be reasonably well preserved over an area of *c.* 1.5-2 ha, c. 150-200 m in size (Fig. 8). It now stands to a height of 2-3

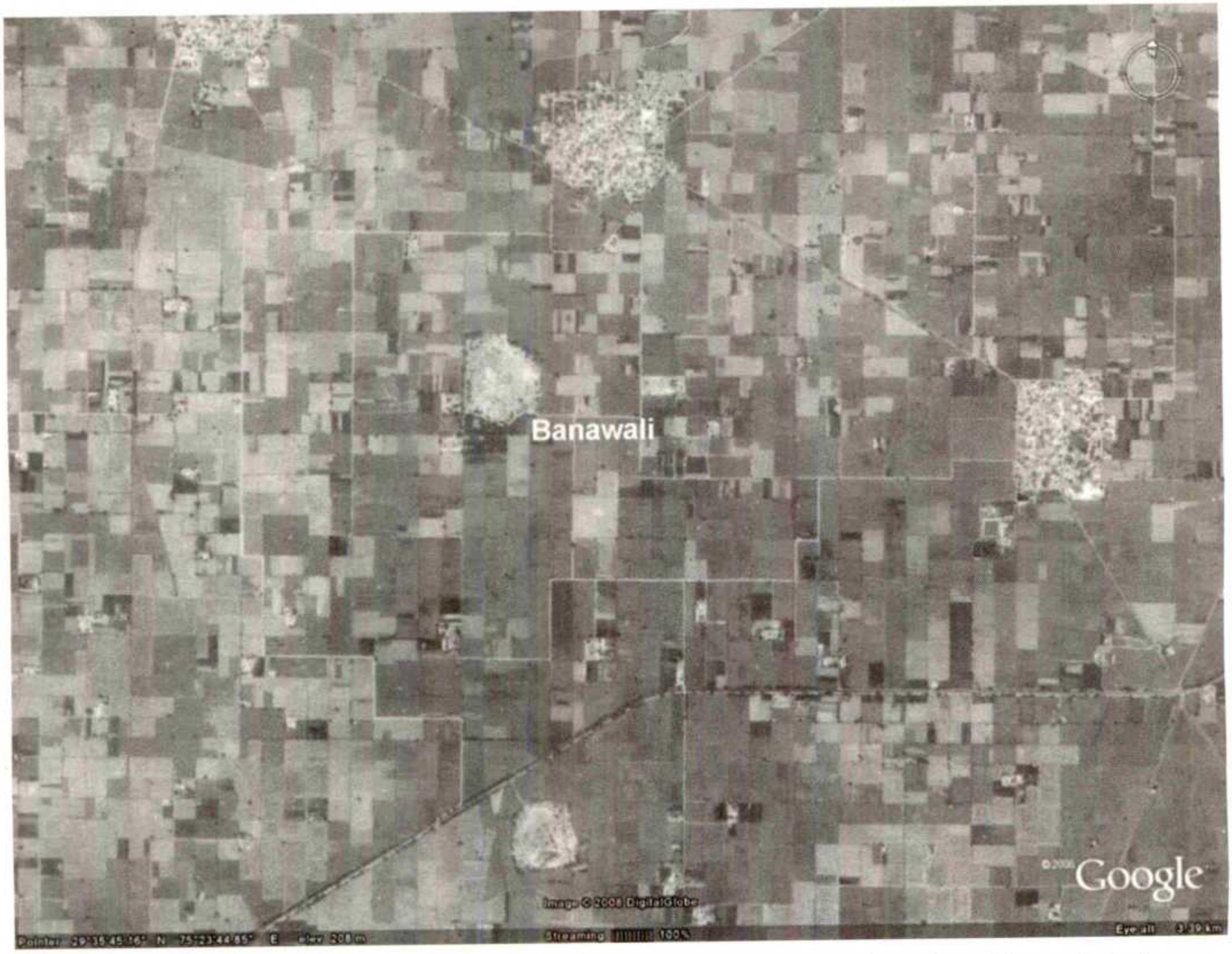
Banawali
©2008 Google
Image © 2008 DigitalGlobe
Pointer 29°35'45.16" N 75°23'44.85" E elev 208 m
Streaming 100%
Eye alt 3.39 km

Fig. 10: Google Earth image of Banawali, showing location of the mound in relation to the modern village, and also in relation to a small site to the south of the main mound

m above the surrounding plain. Its very open field situation would repay systematic and extensive field-walking and geophysical survey, followed by test excavation and micromorpological and palaeo-environmental sampling, as well as further investigation for the presence of a palaeo-channel in its vicinity. The surface of the site shows clear evidence of decayed mudbrick, and there is a decent cover of sherds and other surface artefacts.

Maudi

(Periods of occupation: Mature and Late Harappan)

While driving alone the nullah the runs past the site of Bahola Khatsa, we located one of the mounds at Maudi, which is situated on the other side of the same nullah, about 3 km to the southwest of Bahola Khatsa (Fig. 9). The original survey by Singh (1981; Joshi *et al.* 1984) suggested that both sites have contemporaneous occupation in the Mature and Late Harappan periods.

Mirchpur

(Periods of occupation: Early (Sothi-Siswal), Mature and Late Harappan)

There are two mounds to the north of Mirchpur village, here described as Mirchpur North and South. The North mound lays approximately 2 km north of the village close to a modern Hindu temple. The mound has been largely destroyed by the excavation of a large pond adjacent to the temple. Only a scatter of material extending for about 50 m is clearly preserved. In comparison, the South mound (IAR 1980-1981; Joshi *et al.* 1984) is very well preserved, standing in the middle of an area of cultivated fields. The mound lies approximately 1 km to the north of the village and is preserved to an area of approximately 100 (NS) x 200 (EW) m and rises to a height of 1.5-2 m above the plain. The upper part of the mound has been ploughed flat for cultivation, but conversations with the farmers suggest that crops are only grown in times of rain. It is otherwise too difficult to "lift" the water the required 1.5-2 m to irrigate the area of the site. The north side of the mound has been squared off, and the remnants of the mound suggest that it was once rounded. According to the local villagers, the Chautang once flowed to the east of the mound, but does not any more. Water is reached at a depth of 11.5 m below the surface, and there is a modern pump house located adjacent to the mound.

Mitathal
Periods of occupation: Early (Sothi-Siswal), Mature and Late Harappan

The site of Mitathal (Bhan 1975; Joshi *et al.* 1984) was first excavated by Suraj Bhan in the 1970s, and has recently been the focus of rescue excavations by the collaborative Indian/Japanese team (Shinde *et al.* 2008). The mound has evidence for extensive salt build up on the surface, and an abundance of cultural material is still visible on the surface.

Nagawa
(Periods of occupation: Mature and Late Harappan)

The site of Nagwan (Joshi *et a*l. 1984) is known locally as Nagawa and lies to the west of the village of the same name. The mound is now largely covered by houses that appear to have been constructed in the last decade. The site appears to have been c. 100 x 100 m in size and only rises to a height of 1m above the surrounding plain. The mound lies approximately 3 km to the north of the dry Ghaggar River bed. However, it is likely that this was not the major source of water for the inhabitants of the site as a small nullah flows very close to the west of the site and then into the Ghaggar. This suggests that the larger river is too large and too deeply incised to support sites in this part of the plain. A similar situation was also observed at Dharmheri.

Rakhigarhi
(Periods of occupation: Early (Sothi-Siswal), Mature and Late Harappan)

The multiple mound site of Rakhigarhi is well known (Bhan 1975; Joshi *et al.* 1984: 519; Nath 1998, 2001; IAR 1964-1964, 1966-1967, 1980-1981, 1987-1988, 1997-1998, 1998-1999). The modern villages of Rakhi Khas and Rakhi Shapur now overly large parts of the two main mounds, and neither of these have yet been excavated. In addition to the 5+ mounds at the site, it is also notable that there are an abundance of ponds in this area, including several large ponds to the southwest and north east of the mounds. Most of these ponds appear to be relatively old as there is no longer any spoil on their banks. Also, to the south of the modern villages is a large area of depressed land which collects standing water. A modern temple has been built on an area of raised land towards the centre of this area. These depressions and ponds appear to correspond to areas of lower elevation on the British 1" to 1 mile maps, suggesting that these ponds are not entirely recent. The presence of these features that are so obviously related to water management is certainly interesting. It is possible that these are the remnants of quarrying to procure the sandy silt used to make bricks.

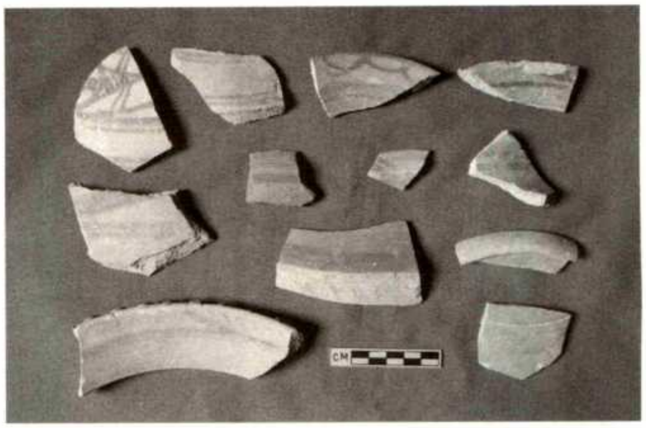

Fig. 11: Some potteries from Gular Wala (Photo: R.N. Singh)

Rattah Theh
(Periods of occupation: Early (Sothi-Siswal), Mature and Late Harappan)

This mound site of Rattah Theh (Bhan 1975; IAR 1980-1981; Joshi *et al.* 1984) is situated between Musa Khera and Rattah Theh villages. The mound has been badly damaged by modern agriculture and only a 100 x 100 m raised area is still preserved to a height of 2m. All four sides of the mound have been truncated by the down cutting of the surrounding fields, and the top of the mound has also been flattened to aid cultivation. There is a large house built on the summit and pottery is visible in most exposed sections

Riwasa
(Periods of occupation: Mature and Late Harappan?)

On the northwestern shore of the Riwasa Playa, behind the modern village and close to a substantial "inselberg" that is topped by a Hindu shrine, a heavily deflated scatter of cultural material was found. Scattered over an area of c. 200 x 50 m, this scatter of material has not been previously recorded. It provides some indication that the Riwasa Playa contained water at some point during the Holocene. The material was difficult to date, but appeared to be either Mature or Late Harappan, suggesting that the lake held water in the 3rd and/or 2nd millennia B.C. (Fig. 12). This suggests that the Riwasa Lake is very suitable for palaeoclimatic reconstruction (see also Saini *et al.* 2005).

Saguan
(Periods of occupation: Historic and later)

The village of Saguan is located adjacent to a very high and large mound that has numerous fired brick structures eroding from the sections. The mound stands to a height of

12-15 m about the plain and is preserved to in excess of 3 ha across this elevation. The brick sizes and forms and the ceramic vessel types indicate that this was a large historic period site.

Discussion and Potential for further investigation

This brief field reconnaissance produced a number of significant results relating to the location and distribution of prehistoric settlements, the preservation of those settlements and the geographical landscapes within which those settlements lie.

Archaeology

There were two interrelated discoveries with regard to site location and distribution: (1) The reconnaissance demonstrated that there are errors in the published geographic locations of a large number of sites in both western UP and Haryana. Virtually all of the site locations that have previously been published have been presented in a latitude/longitude (easting/northing) format using degrees and minutes (e.g. Bhan 1975; Joshi et al. 1984; Possehl 1999; Chakrabarti et al. 2004-5). The absence of seconds or minutes with a decimal place from these site locations means that these are not accurate and this has resulted in a number of errors in site locations ranging from several hundred metres to several kilometers. However, there are a number of site locations that are out by significant margins. This issue has been noted previously (Law n.d.; Cork 2006) and thus far it has only been possible to correct the locations of a small number of sites. As outlined in Table 1, this reconnaissance has made it possible to correct the locations of more sites, including Banawali, Alamgirpur and Gulistanpur. One of the by-products of this was that it was possible to establish that a number of sites are located at some distance from the modern relict water courses, while others are actually located on the banks of ephemeral nullahs rather than rivers.

(2) During the reconnaissance it was observed that a number of villages including Rakhi Khas and Rakhi Shapur, which overlie Rakhigarhi, and other villages in the same area such as Lohari Ragho, appear to have been built on significantly elevated ground. The plains of Haryana and western UP are predominantly flat and areas of sharp elevation are typically either sand dunes or archaeological sites. This makes it very likely that most of the modern villages that are situated on elevations are actually built on top of archaeological sites and/or sand dunes. While this is interesting in and of itself, it has particular significance when it is noted that many of these elevated villages are not included in the lists of known prehistoric archaeological sites.

The combination of errors in site location and the fact that numerous sites are missing from the current lists of site distributions has major ramifications for our understanding of the distribution of prehistoric settlement, particularly when it comes to understanding the environmental context of sites. Any attempts to assess the geographical context of prehistoric archaeological sites in Haryana and western UP using the existing data set of prehistoric site locations are thus likely to be fundamentally flawed. This is of critical importance when it comes to interpreting the landscape contexts of Harappan and later sites, particularly the relationship between archaeological sites and the relic river channels that are in evidence across the plain.

The substantial inaccuracies in the existing archaeological data set critically impede our understanding of the precise relationship between archaeological sites and the palaeochannels seen on satellite imagery. To establish the geographical context of archaeological sites in NW India all known Harappan period sites in the region should be resurveyed in order to establish their precise location, size and when they were occupied, and systematic survey must be conducted in specific study areas. These data should be combined with a detailed GIS landscape analysis and the results should be correlated with the results of targeted excavations of sites within those study areas, which is carried out in parallel with this survey based work. Such an analysis will demonstrate the precise relationship between the archaeological sites and the modern and ancient water courses that are preserved across the plains, and will provide a clear impression of the relationship between settlement, water resources and the landscape. Excavations at several small sites discussed above should be aimed at recovering well stratified cultural material, carbonized organics for new radiocarbon assay, samples for phytolith and soil micromorphological analysis, and samples for flotation to collect macro-botanical remains. A multi-strand analysis such as this will allow for a far more refined interpretation of site date range, use and function than is currently available. Elements of this programme would be similar to that conducted around the site of Harappa (Schuldenrein *et al.* 2004, 2007; Wright *et al.* 2008).

Geoarchaeology

In terms of the geoarchaeological and geomorphological elements, there are a number of rather obvious but important wider factors which will affect the project's investigations:

1. The landscape is one of very low relief. Thus locating adequate geomorphological sample locations depends on existing man-made cut features such as canals and quarries for mud-brick manufacture, or on borehole and geophysical surveys.
2. The apparent great depth of fill in the valley systems (i.e. the Yamuna, Hindon and Ghaggar) makes the task

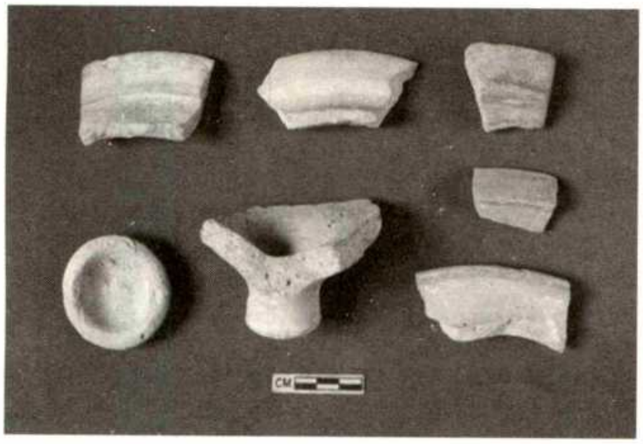

Fig. 12: Ceramics from Riwasa (Photo: R.N. Singh)

of identifying early Holocene land surfaces and palaeosols much more difficult through conventional geomorphological survey.

3. There is much recent denudation of the survey areas. This includes extensive down-cutting of whole fields by anything from about 1 to 3 m for procuring silt and very fine sand material for the making of mud-bricks and fired bricks on anything from a local to large industrial scale. Once quarried, these areas are often returned to arable cropping, making recognition of landscape truncation measured in terms of several tens of hectares much harder to recognize. This has severely affected a number of Harappan sites that were visited by the team.
4. Many of the previously mapped Harappan sites that are not protected by state or national governments are either poorly located, and/or have been affected by urban/town development, local quarrying for building materials, and the construction of farms/farm buildings.
5. There is much anecdotal evidence available from local farmers about the nature and extent of flooding taking place during the annual September monsoons and the proximity of the available groundwater table. All spoken to suggest that there has been much less or no flooding over the last decade, and a lowering of groundwater tables, a situation which gets worse year by year.

There are considerable problems of deformation of the modern landscape and the associated Harappan sites, mainly in Haryana. In conjunction with the geographic and archaeological work, detailed geomorphological investigations should be undertaken at sites that are excavated. In terms of site specific micromorphological studies of construction materials, floor composition and preparation, and occupation sequences, there is great potential at a number of sites within the survey area. This work could easily be on the scale of work as done at Catalhoyuk in Turkey and other Near Eastern tell sites (Matthews *et al.* 1997) and will be the subject of the UKIERI funded Ph.D. studentship in the Department of Archaeology at the University of Cambridge.

Geography

The palaeochannels that cut across Haryana and parts of Rajasthan are readily recognized on satellite imagery, but it is unclear when and why the river ceased flowing. The prevailing opinion is that it was originally fed by the Yamuna and Sutlej Rivers and that it dried due to a combination of tectonic activity and river capture. This reconstruction is seemingly supported by satellite remote sensing, but the date that this occurred is the critical factor, since this is essential for correlating this process to the cultural evidence. In order to determine the sub-surface extent and architecture of these channels and their alluvial stratigraphy and sedimentology, electrical resistivity and ground penetrating radar analysis can be carried out in order to establish where sediment cores can be drilled. Several cores need to be drilled across each channel and the sediments contained in the cores that are collected can then be dated using OSL and AMS radiocarbon analysis to date when the channels ceased flowing. The sediments within the cores themselves can also be analysed to establish the nature of sedimentation and the provenance of those sediments at different points in time.

Palaeoclimate proxy studies suggest that the approximate time of the Harappan Civilisation was a period of declining monsoon strength, punctuated by episodes of aridity. However, we lack reliable information about past environmental conditions on the plains of NW India, particularly the summer and winter rainfall patterns during the Holocene. The closest local climate proxy evidence comes from lakes in Rajasthan that are subject to different environmental and rainfall systems. The Riwasa Lake lies at the edge of the plains and appears to have an extensive sequence of sediments that contain mollusc species throughout (Saini *et al.* 2005). To reconstruct the local palaeoclimate and rainfall patterns of NW India cores could be drilled into Riwasa Lake. Magnetic susceptibility and clay mineralogy analysis would identify subtle pedogenic events induced by climatic fluctuations and estimate paleo-precipitation, and carbon and oxygen isotope analysis of molluscs and lake sediments would reconstruct the Holocene palaeoclimate. Preliminary analysis will also establish whether pollen and diatoms are preserved.

The *in situ* and reworked floodplain dune systems in both the Yamuna and Hindon valley systems require dating, although it is likely that they are of pre-Holocene age. If these dunes were substantially mobile during the Holocene, then it is highly likely that the processes involved in their formation would have had a dramatic impact upon the human population of the plains. If however, they were not mobile during the Holocene, then this indicates that the dunes would have been a static and very visible component of the landscape of the Haryana plains. In addition, the sands in the river floodplain require provenance studies; for example are they sheet-wash deposits derived from the Himalayas to the northeast, and/or the result of changing river dynamics during the Holocene. This riverine history, of both dating and provenance, are crucial to understanding the mid-Holocene environments associated with the Harappan sites, and the possible nature of their agricultural system.

Summation

By looking at the relationship between the geographical and landscape context and the archaeological evidence for human occupation, existing hypotheses about the impact of the environment on the Harappan civilization can be re-examined, particularly as they relate to water systems. It will be by determining the precise relationship between settlement, water resources and the landscape, that it will be possible to establish how the human populations of NW India interacted with the land for the first time. Evidence for rainfall patterns and the relationship between sites and water courses of different sizes and types has the potential to force a substantial re-evaluation of the Harappan settlement and agricultural system in this area, which will have major ramifications for our understanding of long term cultural development in this region.

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Indor Khera Revisited: Excavating a Site in the Upper Ganga Plains

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Abstract

This article concentrates on the early occupational history of the site of Indor Khera in the Upper Ganga Plains, based on excavations conducted in 2006 and 2007. In 2007, one of the test trenches excavated in 2006 was reopened and a more extensive area (approximately 15 x 15 m) was excavated. The intention is to focus on the results from a single trench that have provided us with a tentative which has chronology for the early history of the site and which has also opened several questions for discussion. The issue of the use of the term 'Early Historic' is also discussed.

Introduction

The site of Indor Khera (28° 14'57" N, 78° 12'48" E) is located in Tehsil Debai[1], District Bulandshahr, Uttar Pradesh on the right bank of the eastern branch of the Chhoiya Nadi, also called Nim Nadi. Indor Khera lies between the rivers Kali Nadi and the Ganga (Fig 1). The village of Indor is located 0.5 km off the Aligarh-Anupshahr road and is about 10 km east of the Ganga River. Three test trenches were opened at Indor Khera in 2006. In 2007, one of the test trenches was reopened and a more extensive area (approximately 15 x 15 m) was excavated. However, this is not a report of the work of the two seasons. Rather than presenting the data in the form of preliminary findings from the seasons' work, the intention is to focus on the results from a single trench that have provided us with a tentative chronology for the early history of the site and have also opened several questions for discussion.

Why did we choose Indor Khera?

In the Upper Ganga plains, after Atranjikhera and Jakhera, hardly any sites have been excavated on a sustained basis in the last decade, in contrast to work conducted in the Middle Ganga plains. Moreover, even with these two sites, we know little about the 1st millennium CE, as the post-Northern Black Polished Ware levels from Atranjikhera remain unpublished and Jakhera was deserted after the Northern Black Polished Ware occupation. It is this period, significant in the history of ancient urbanism, which in many ways dictated the initiation of this project. A number of sites were explored and out of these, Indor Khera to us appeared suitable as it was a small site (about 12 ha) with a number of small mounds, ranging from around 0.1- 0.6 ha, with heights of 1-2 m. Some of these small mounds lay on the other side of the river Chhoiya, but all the mounds were to the north and west of Indor Khera. These mounds lay in a radius of about 500-600 m from the edge of the Indor Khera mound. There was thus a potential to explore the relationship between the main mound and subsidiary mounds. A relatively small site like Indor Khera allowed investigation by a small team such as ours with limited resources and infrastructure.

Initially, the project was conceptualized as a survey of a site in its landscape, with the intention of undertaking intensive field walking in a 2 x 2 km area around the mound (Menon *et al.* 2005). In this first stage, undertaken in two phases in December 2004 and in May-June 2005, the area around the mound was surveyed, but as regards the mound itself, there were two problems. Firstly, nearly half the mound was occupied by the village and was thus unavailable for survey. Secondly, while the other half does not have houses, it is however being used for animal enclosures and for storing cow dung cakes and husk. Thus, the actual mound itself could not be surveyed. While this survey provided us with information on activities taking place outside the walled area, for understanding different activities and architecture within the walled area, excavation was necessary.

The present day village is located on top of the mound, which measures 285 m (north-south) x 428 m (east-west). The maximum height of the mound is now 17 m. As mentioned in our earlier article (Menon *et al.* 2005), A.C.L. Carlleyle (1879: 56) had first investigated the site in 1874-75. He had then mentioned that the village occupied an area of 152 x 152 m in the east-north-eastern side of the mound. Today the village extends over the entire eastern,

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[1] Till 2005, the modern village of Indor was under the tehsil of Anupshahr. As a result of the creation of new tehsils and districts in Uttar Pradesh, Indor has now been put under Tehsil Debai.

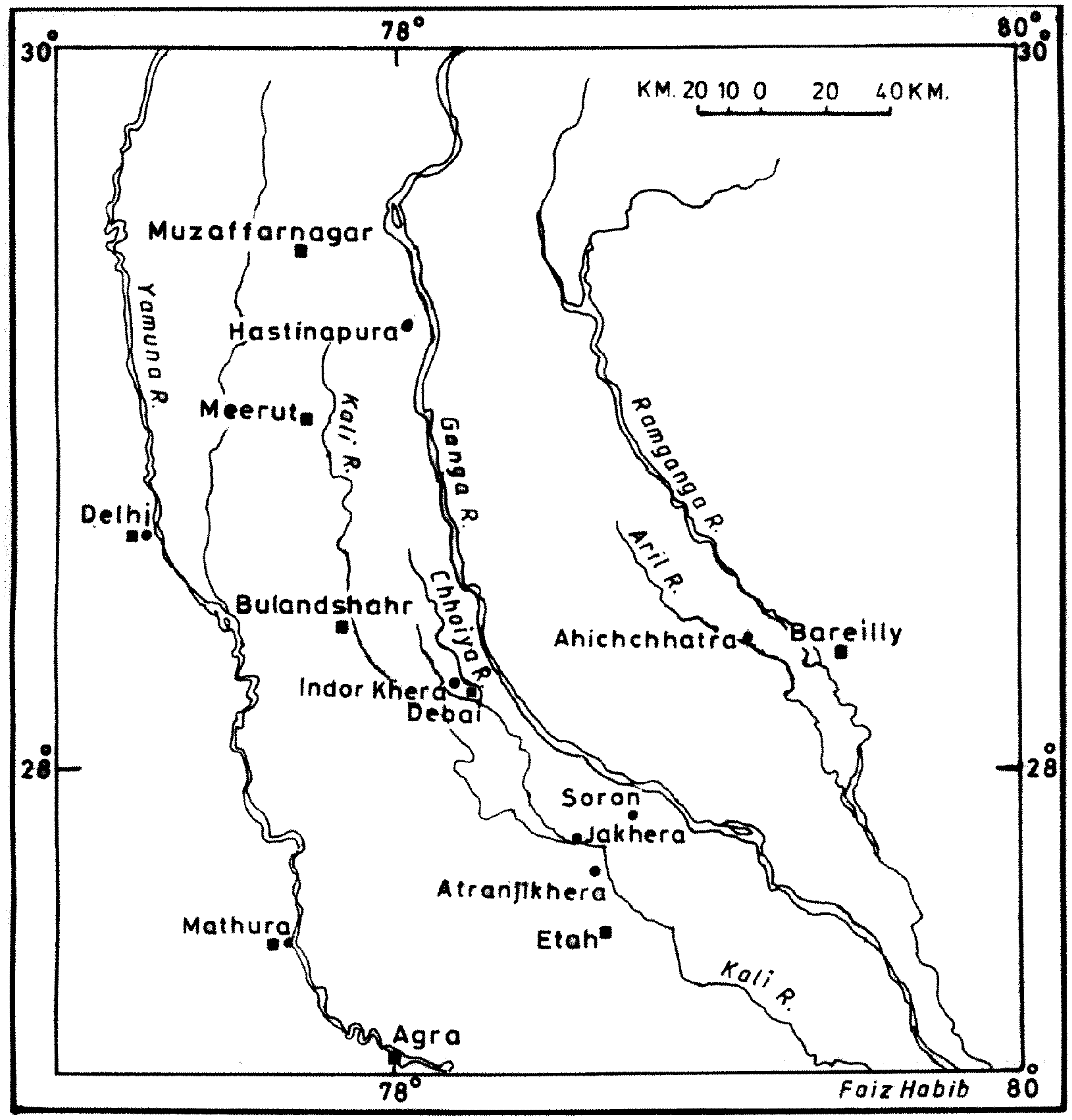

Fig.1: Map of archaeological sites showing location of Indor Khera

northwestern and southeastern portions of the mound and the adjacent area (Fig. 2). The extension of habitation at the base of the mound has led to the clearing and exposing of fortification walls particularly in the northern, eastern and southern parts of the mound. The fortification walls (Fig. 3), made of baked bricks, with dimensions ranging from 38-43 x 22-23 x 5.5-6 cm, comprised an inner and an outer wall, with cross-walls. Carlleyle (1879: 56-57) conjectured that there were four gateways, suggested on the basis of deep hollows or ravines cutting through the mound in the western, north-northeastern, southern and eastern portions. However, he was doubtful about the last as there was no evidence in the form of a depression. There are clear gullies in the west, north and south (Fig 2), which are even now used as pathways through the mound. As far as the possible eastern gateway is concerned, during Carlleyle's time itself this area was occupied by the village which may have removed all traces of it.

Preliminary soundings were made in May-June 2006 by opening two 4 x 4 m trenches (A1 and A2) at about the 196 m contour line on the southern edge of the mound (Fig. 2). Another trench, A3, initially had a cutting area of 4 x 2 m, which was reopened in May-June 2007 when it was also extended into a 4 x 4 m trench. A3 was about 100 m east of A1 and A2 and was at a lower level (193 m contour line) than the other two trenches. While A1 and A2 were excavated up to 2 m and 1.5 m, respectively, A3 was dug till 4.26 m in 2006 and up to natural soil, in the northwest quadrant, at 5.86 m in 2007.

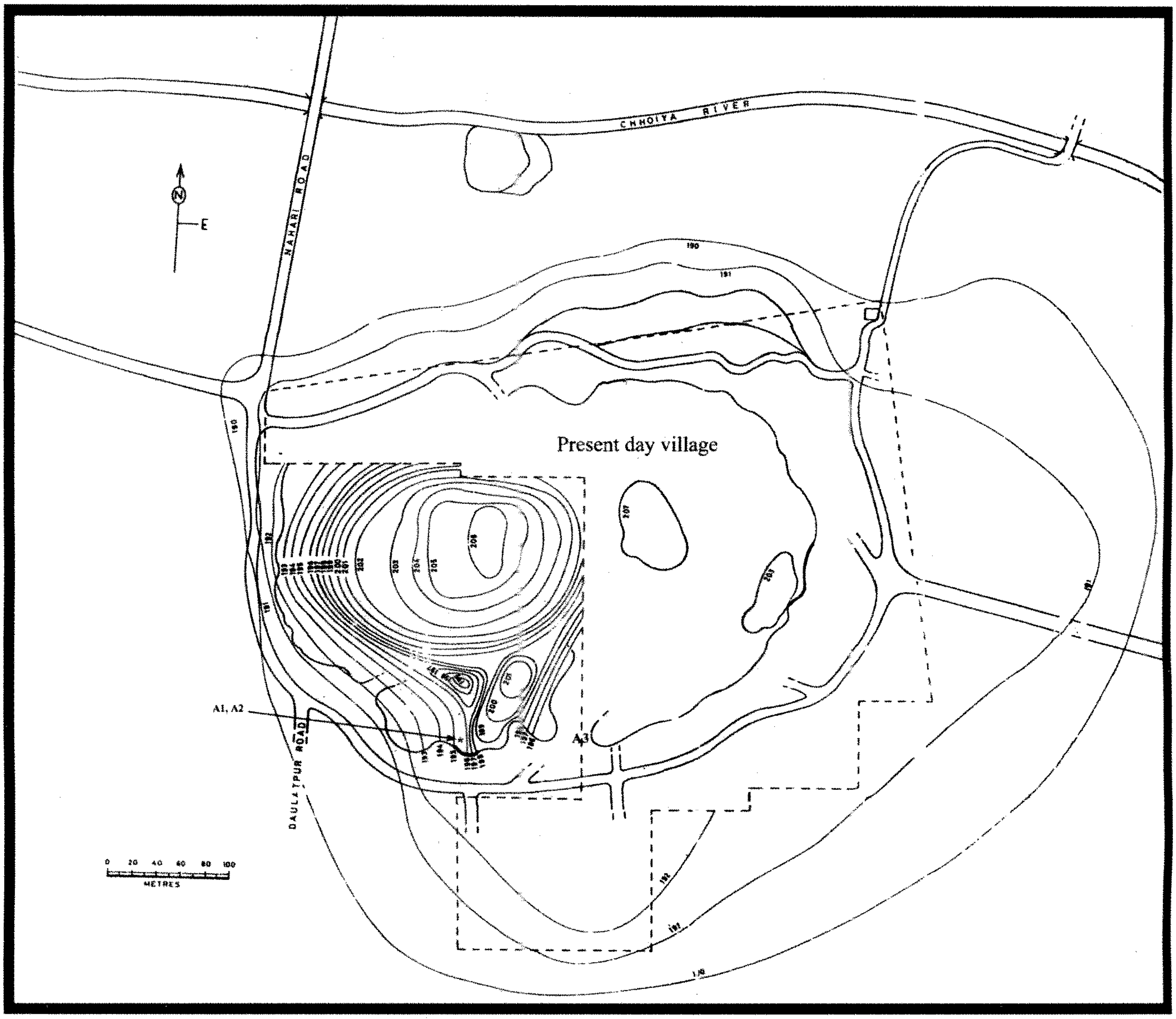

Fig.2: Contour plan of Indor Khera

The information from A3 also enabled us to plan further research at the site, which required horizontal excavation. For this purpose we chose the northwestern area of Indor Khera where there was a flat exposed ridge halfway down the slope of the mound (at about the 193 m contour line). The deliberate cutting away of the mound by local villagers created this ridge. From the ridge there was a clear vertical section ranging from 3-4 m till the next higher portion of the mound. Except for the deliberate plantation of a few trees and two '*bitiyas*' (a structure composed entirely by the heaping of cow dung cakes and plastering the whole with wet cow dung), the area was free for excavation. The preliminary findings of the excavations in this area will be discussed elsewhere.

The trench (A3) was laid at about the 193 m contour line. The spot was chosen for two reasons: the remains of the fortification in the southern part of the mound going up to the height of about 194 m, as well as the likelihood of a gully in this vicinity (now a brick-laid path) being an ancient gateway. A3 is just off this path and about 10-15 m within the line of the fortification. The area where A3 was laid out was a clearing where buffaloes were penned. The owner was kind enough to move his animals to another spot for the duration of the excavation.

While A3 was largely dug in arbitrary units of 5-10 cm, recognized features were excavated separately. The deposits were dry sieved using a mesh size of 2 x 2 mm. Once the lower levels (about 3 m) were reached, the soil became clayey making dry sieving difficult; the deposit then had to be hand sorted. All archaeological material was kept, including pottery, artefacts, bones, and macro-botanical remains like seeds. Wet flotation was also done of soil samples for micro-botanical remains. Charcoal samples were collected from different depths and kept for dating. While some of the charcoal samples have been sent for radiocarbon dating to Birbal Sahni Institute for Palaeobotany, others have been retained for AMS dating.

As mentioned earlier, first the northern quadrants of A3 were opened giving a cutting area of 4 x 2 m. At a depth of 2 m, a 1 m wide step was left unexcavated in the northeastern quadrant. This was to facilitate access to the lower levels. At a depth of 3 m, another 1 m wide step was left intact, leaving only the northwestern quadrant (2 x 2 m) as the excavated portion. This was dug up to 4.26 m in 2006. In 2007, the trench was reopened, and we reached the natural soil at 5.86 m in the northwestern quadrant. To confirm the latter, the quadrant was further excavated down till 6.20 m. At the same time, the trench was extended to include the southern quadrants, giving a cutting area of 4 x 4 m. In the southern quadrants, we stopped at the level of the first step reached in the northern quadrants.

Stratigraphically, we identified 28 layers in the northwestern quadrant of A3 (Fig. 4). The layers were deliberately not marked out on the section with a knife and sections were drawn in consultation with all the excavators. On the basis of archaeological finds, layers 11-28 (3.11 – 5.86 m) belonged to Period I; layers 3 to 10 to Period II (0.70 – 3.11 m); and layers 1 and 2 to Period III (surface to 0.70 m). This periodization has been worked out on the basis of stratigraphy as well as changes in material culture, including pottery. For the purpose of this article, we are still retaining conventional ceramic categories, in terms of particular diagnostic wares, such as Black Slipped Ware, Painted Grey Ware, and Northern Black Polished Ware. While these have been found useful as chronological markers, it has often meant that the associated wares have been largely neglected. Adequate attention has also not been paid to the kind of information that can be ascertained regarding the changes taking place over time in relation to the production and use of pottery. The tabulation and codification of the pottery of Indor Khera is under progress and will be published separately.

Period I

The deposits associated with Period I are compact, clayey and dark brown in colour. In layer 27, were found *in situ* two mandibles and a tooth near an oval-shaped feature of baked clay and ash. Nearby were also found 5 pieces possibly of a single bangle of copper. Layer 26 is a yellow compact layer about 4 cm thick and was possibly a floor. Associated with this floor were two *ghata* shaped beads and terracotta bangle pieces. Layer 23 represents a burnt deposit. Layer 18, represented by a 4 cm thick yellow compact deposit, was also possibly a floor. There was a large pit or silo, going down 1.20 m with a width of 1.10 m and a mouth of 0.35 m, sealed by a yellow compact layer 16. Black Slipped Ware, Fine Grey Ware, Painted Grey Ware, Black-and-Red Ware and Red Ware were found from these levels. As Painted Grey Ware dates are well established, we can date this period between 1000 and 700/600 BCE. Charcoal samples from Period I levels of Indor Khera were collected and will be given for analysis.

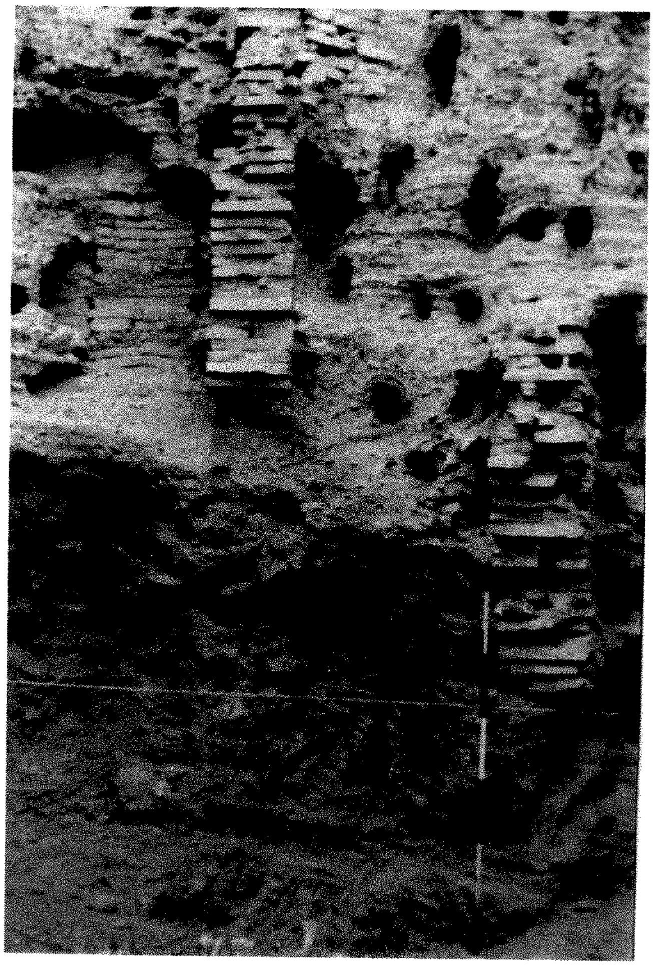

Fig.3: Fortification walls of Indor Khera

Period II

Period II begins with the black layer 10 into which Feature 6, 10 cm thick, was built of yellow compact clay. Feature 5, 20 cm thick, as seen from the section (Fig. 4) had collapsed in the western portion. This feature was composed of brick gravel and small potsherds. About 10 cm above Feature 5 is Feature 4 which along with Feature 3 was contemporary to layer 4. Feature 4, 8 cm thick, was also composed of brick gravel and potsherds, with a bedding of brickbats and brick nodules. Feature 3, about 15 cm thick, comprised of lime laid over a bed of tiny brick chips and brickbats. The base underneath Feature 3 was comprised of brick chips, brick nodules and brickbats. Feature 3 was oriented in a southwest-northeast direction (according to magnetic north). At the level of Feature 3

Table 1: Quantification and description of finds in Period I

Material	Object	Description	Count
Terracotta	Bead	Red	
		Ghata shaped	2
		Arecanut shaped	1
		Pear shaped	1
		Convex	1
	Bangle piece	Black	
		Triangular section, with design of impressed lines on both sides of central ridge	10
		Red	
		Triangular section, no design	6
		Triangular section, with design of impressed lines on both sides of central ridge	17
		Round section, no design	7
		Round section, with design of impressed lines on both sides of central ridge	2
		Round-triangular section, design of faint incised lines	1
	Marble	Black	4
	Disc	Black	
		Design of incised lines on both edges	1
		Red	
		Design of incised lines on edge	2
		Without design	1
	Potsherd disc	Red	7
	Wheel	Red	
		Without hub or spokes	3
		Grey	
		Hubbed, no spokes	1
	Gamesman	Red	1
	Figurine	Red	
		Part of an elephant's trunk	1
	Ring	Red	1
	Unidentified		11
Clay	Miniature vessel	Unbaked	1
Bone	Point		3
Copper	Bangle piece		5 (probably part of 1 bangle)
	Unidentified		2
Iron	Unidentified		5
Silver	Sheet	1.2 cm square	1
Glass	Bead	Blue	1
	Chips	Green	
	Unidentified	Green	1
	Misshapen piece		1
Stone Carnelian	Bead	Spherical	1
Shell	Bead	Barrel disc	1
		Cylindrical	1
Mica	Fragments		

was Feature 1 in the northwestern quadrant. The floor of Feature 1 was outlined by a circular line of brickbats. The feature, going down 1.25 m from layer 2 which seals it, was composed of alternating layers of ashy white, grey, brown and blackish deposits. Quantities of slag were found within the feature. There is a possibility that Feature 1 may initially have been constructed as a fire installation. Feature 2, 8 cm thick, with a bed of brickbats is mostly damaged but was made of rammed potsherds in clay. The decreasing widths of Features 2, 3 and 4 as seen from Fig. 4 probably indicate a change in direction as compared with Feature 5. As Feature 5 is visible in the entire west-facing section, it can be assumed that the width of this feature would have been at its minimum 4 m. Our interpretation is that Feature 6 was an unpaved road which was subsequently followed by Features 5, 4, 3, and 2 which were paved roads. These successive roads in Period II were probably originating from a gateway perhaps at the gully near A3. Between Features 3 and 4, in the southwestern quadrant were found a collapse of several large bricks with two partly intact (34 x 22 x 6.5 cm), along with large bones, burnt bones and 37 beads (34 orange, disc, glass; 1 blue, micro, glass; 1 shell; 1 red stone, rectangular), all possibly part of a single necklace.

Period II is characterized by Northern Black Polished Ware. Two terracotta sealings (see the upper two in Fig. 5) were found. Neither was inscribed but both have symbols on the basis of which they have been identified as belonging to the Mauryan period by Prof. Pushpa Prasad, an epigraphist formerly at the Department of History, Aligarh Muslim University.

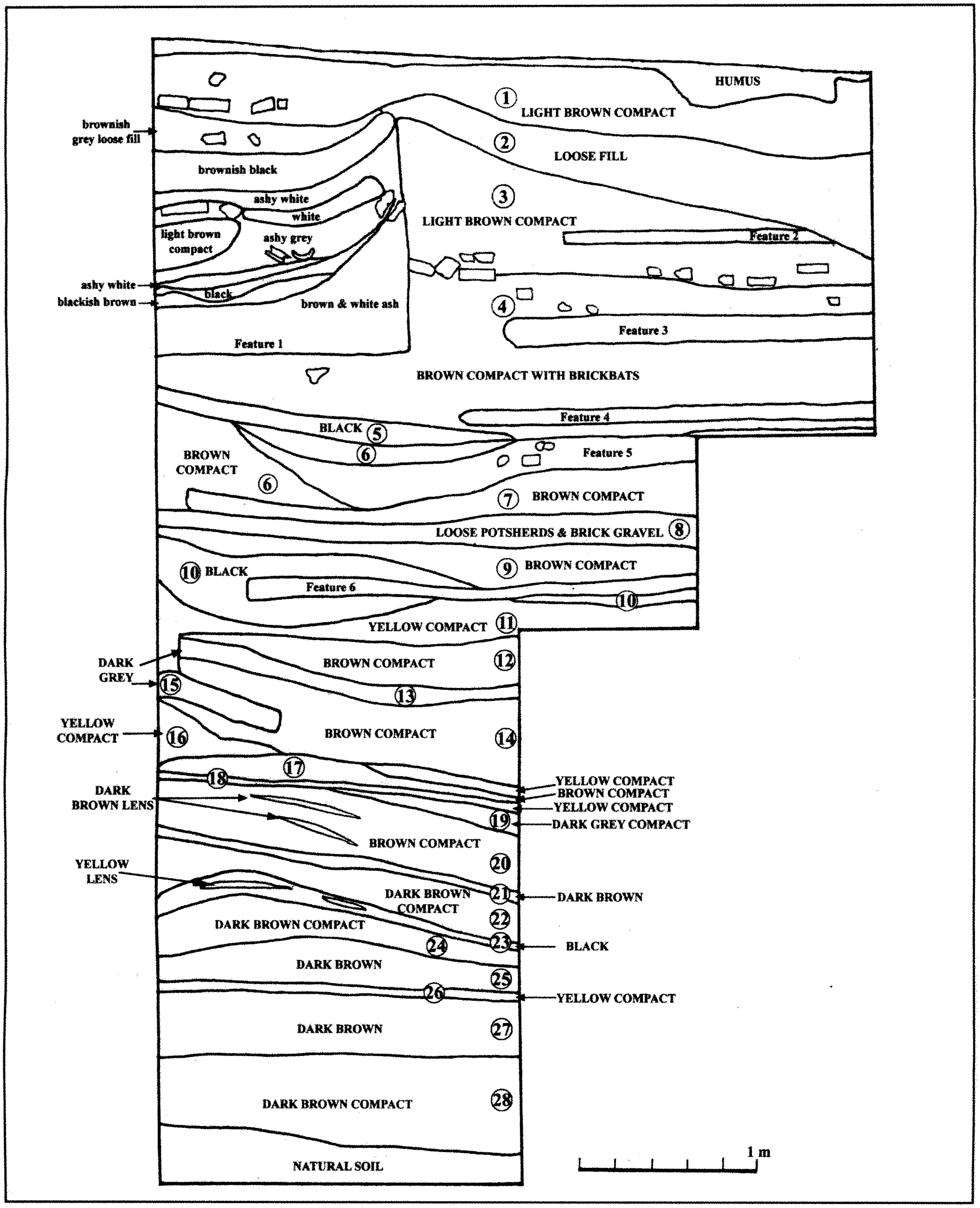

Fig. 4: Stratigraphy of trench A3

Table 2: Quantification and description of finds in relation to features from Period II

Context	Material	Object	Description	Count
Bed of Feature 2	Terracotta	Bead	Black	
			Arecanut shaped	1
	Wheel	Red		1
Bed of Feature 2	Glass	Bead	Blue	
			Uneven disc	1
			Round barrel	1
Feature 5	Terracotta	Bead	Black	
			Arecanut shaped	
			Short bicone	
			Globular	
			Red	
			Arecanut shaped	
			Short truncated bicone	
			Ghata shaped	
		Bangle piece	Red	
			Triangular section, with design of impressed lines on both sides of central ridge	
		Marble	Black	
			Red	
		Disc	Red	
			With incised lines on both sides	
		Potsherd disc	Red	
		Figurine	Red	
			With design of punched circlets	
			Black	
			Bird with perforation in the bottom	
		Button	Red	
		Unidentified		
Feature 5	Bone	Point		2
Feature 5	Copper	Coin?		3
		Unidentified		7
Feature 5	Iron	Unidentified		5
Feature 5	Lead	Unidentified		2
Feature 5	Ore	Galena (lead sulphide)		2
Feature 5	Glass	Bead	Orange, disc	3
			Black	1
			White-green, micro-bead	1
			Sea-green, micro-bead	1
		Misshapen piece		2
Feature 5	Stone			
	Quartz	Bead		1
Feature 5	Shell	Bead		3
		Bangle piece	With grooved edges	1
		Waster		1
		Chips		
	Cowries			2

Period III

It appears that Feature 1 possibly built as a fire installation (kiln /fire place) in Period II, may have fallen into disuse and began to be used as a refuse area in this period. We are assuming that Feature 2 had either changed direction or gone out of use. A 20-50 cm thick loose deposit (layer 2) of potsherds probably represents a fill to level the area. This was followed by a compact light brown layer 1 which indicates that this area perhaps once again came into use as a residential area. One sealing (Fig. 5 bottom) was found on the surface of A3 and has Brahmi characters inscribed in circular fashion. This has been read by Prof. Pushpa Prasad as *Bhagvatasya* and dated to the early 1st century A.D. These layers can perhaps be dated from 200 B.C. - 100 A.D. as indicated by the ceramic assemblage, which is marked by Red Wares, an absence of NBPW, and the inscribed sealing.

As can be seen from tables 1-5, in Period I, basic materials used were terracotta, iron, and bone, with some amount of shell, silver, carnelian, glass, copper and mica. In Period II, there is both a quantitative and qualitative increase. Qualitatively, there are now identifiable iron objects, terracotta animal figurines, carved bone and ivory objects, copper coins and miniature stone vessels. New materials added in Period II were schist, lead (and its ore, galena), cowries, ivory and a range of semi-precious stones, like soapstone, moss agate, jasper, quartz, black agate and chalcedony. As apparent, there is also a quantitative and qualitative increase in glass beads. In Period III, no new materials were added.

The apparent quantitative increase in finds in Period II has to be treated with caution. The volume of earth excavated for the three periods in Trench A3 was 11.0, 26.8 and 11.2 m³, respectively. Far more earth was

Table 3: Quantification and description of finds in Period II

Material	Object	Description	Count
Terracotta	Bead	Black	
		Arecanut shaped	6
		Pear-shaped	1
		Misshapen	1
		Red	
		Ghata shaped	1
		Red	
		Without design	1
		Black	5
		Red	2
	Disc	Red	
		Without design	2
	Potsherd disc	Red	6
	Figurine	Red	
		Seated lion	1
		Red	1
		Red	1
	Sealing	Red	2
	Unidentified		10
Bone	Comb		2
	Point		1
	Ring		1
	Unidentified		1
Copper	Coin?		8
	Ring		1
	Rod		1
	Lumps		8
	Unidentified		7
Iron	Nail		1
	Rod		1
	Unidentified		3
Glass	Bead	Blue, truncated barrel	3
		Amber, truncated barrel	1
		Orange, disc	39
		Blue, micro	25
		Green, micro	18
		Black, micro	8
		White, micro	1
		Green, long convex bicone	1
		Black, short tubular	2
		Blue, collared	1
		Green, tubular	1
		Black	1
		Blue, fragments	
	Misshapen piece	Black	8
	Chips	Blue and grey	
Stone	Bead	Red, rectangular	1
		Garnet, misshapen	1
		Black, short barrel	1
Schist	Chip		1
Soapstone	Rim sherd		1
Carnelian	Bead	Long barrel	1
		Short truncated	1
		convex bicone	1
		Faceted	1
Moss agate	Bead	Rectangular	1
Jasper	Bead	Faceted	1
Quartz	Bead	Tablet shaped	1
Black agate	Bead	Barrel	1
		Globular	1
Chalcedony	Chip		1
Shell	Bead	Disc	6
		Short barrel	5
		Triangular	1
		Irregular	1
	Bangle piece		1
	Cowrie		34
Ivory	Decorative object	Carved with flower and pot design with tiny holes on margin for fixing	1

excavated for Period II as compared to the preceding and succeeding periods. This quantitative increase in Period II is the evidence from a single trench. It would be interesting to see whether it holds in other areas in subsequent excavations.

The excavations of the test trench A3 have proved useful in providing us with an early occupational history for the site, one that was not known so far from Carlleyle's investigations. This would obviously hold for a limited area in the southern part of the mound. The hypothesis about a possible entrance to the fortification in the southern part was confirmed by the evidence of successive roads near the gully still bifurcating the southern part of the mound. From the trench, also recovered were wasters and chips of stone (schist and chalcedony), and shell, misshapen pieces of glass, lumps of copper, an antler piece, a lump of galena, and slag that still has to be identified, all testifying to possible craft activities. The

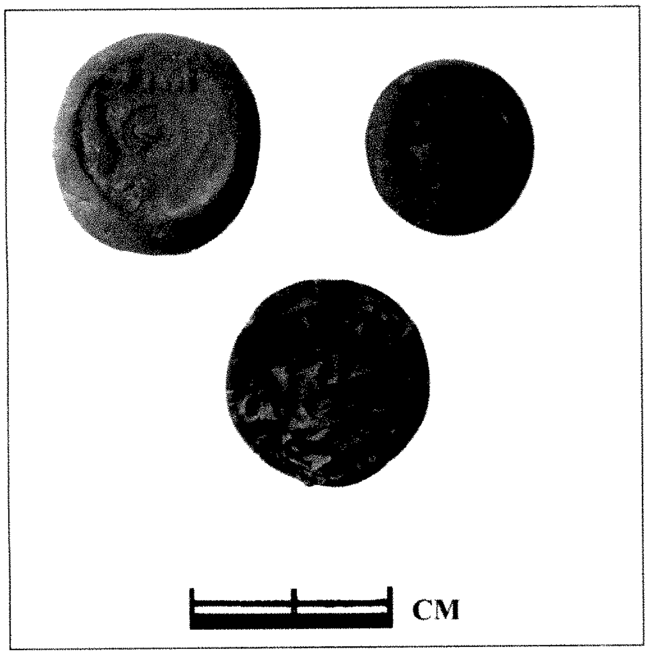

Fig.5: Terracotta sealings from trench A3

evidence of craft working from a small test trench indicated the potential of the site. Contexts of craft production for the 1st millennium B.C./A.D. are all too rare in the archaeological work done so far. Thus, further work at this site was planned to investigate the spatial distribution of craft and other activities both within and outside houses.

Postscript

One issue that has been troubling us of late is the term 'Early Historic' (see Menon 2008), so commonly used by archaeologists and that includes us as well. As we began formulating our research problems, it became apparent that not only is there no consensus but, in fact, there exists a lack of clarity in what 'Early Historic' means in archaeological terms and the way it has been used by archaeologists[2].

As we understand, there are two major problems involved with the use of the term 'Early Historic' by archaeologists. First, can one use the term 'Early Historic' for the entire subcontinent when there are clearly differences across space and time? The beginning of the 'Early Historic' has varied from Erdosy's (1988, 1995) dates of 1500 B.C. for the Punjab and 1000 B.C. for the Ganga Valley, to Dhavalikar's (1999: 161-63) dates for different parts of the subcontinent: 600 BCE for the Ganga Valley, 400 B.C. for Western India and 200 B.C. for South India. The terminal dates also find little concurrence. Erdosy (1988, 1995) dates this in the Ganga Valley to 300 A.D., while Dhavalikar puts it at 600 A.D. in the Ganga Valley and in Western and Southern India, 300 A.D.[3] On the other hand, Ghosh (1989) and Smith (2006) have a single time-span for the subcontinent as a whole, but their dates vary from the 6th century BCE to the 6th century A.D. and from 3rd century B.C. to the 4th century A.D., respectively.

Second, in terms of material culture, the Harappan, for example, is clearly identifiable but how would we recognize the 'Early Historic' and is it even possible to do so? Given the spatial and temporal variations, can the 'Early Historic' be considered as a single, homogenous entity? Perhaps a certain assumption has been made in conflating the 'Early Historic' with urbanism, the beginning of writing or even dynasties, as those from the Mauryans onwards[4]. It may perhaps be more useful for archaeologists to discard a term like 'Early Historic' altogether and instead work out changes in material culture, over time, which in turn could reflect transitions and transformations of socioeconomic structures in the 1st millennium B.C.

In the same vein, it is time we reflected on the usefulness in India of persisting with a kind of 'Historical Archaeology' where the prime focus of archaeology has been on confirming the information from texts. Often, one finds that for periods for which written records exist, archaeological evidence tends to be subordinated to the textual. However, while texts provide us with certain kinds of information, archaeology provides us with very different insights. For example, let us take the case of urbanism. Chattopadhyaya (2003) in a perceptive article discusses how texts may inform us on the ideal city, on its hierarchic use of space, as a point of convergence, and the attitudes to, and meanings of urban life. On the other hand, archaeology can tell us about domestic activities, scales of production and the appurtenances of daily life. Unlike the texts which largely provide abstracted images, the advantage of archaeology lies in its ability to provide us with a narrative of the lived experience. However, for this, research questions have to be refined and more sophisticated methodologies adopted in archaeology.

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[2] Chattopadhyaya (2008) has recently delineated some of the problems that concern the use of the term "Early Historical' in Indian archaeology.

[3] For some other archaeologists such as Tewari (1997-98; Tewari *et al.* 1999-2000), the first half of the 1st millennium A.D., the post-Northern Black Polished Ware period, has generally been designated either as "Early Historic" or as Sunga, Kusana and Gupta periods. However, changes observed in material cultures are not likely to coincide with dynastic change.

[4] One exception is Erdosy who has used the term 'Early Historic' for a period from when the earliest texts are known.

Table 4: Quantification and description of finds in relation to Feature 1

Context	Material	Object	Description	Count
Feature 1	Terracotta	Bead	Black	
			Arecanut shaped	8
			Spherical	1
			Red	
			Arecanut shaped	4
		Marble	Black	1
			Red	2
		Potsherd disc	Red	1
		Games man	Red	2
		Figurine	Black	
			Broken. Hind portion of animal figurine with incised dots	1
		Button	Red	1
		Unidentified		3
Feature 1	Clay	Disc	Unbaked. With central perforation and tiny perforations around the rim	1
Feature 1	Bone	Pendant		1
		Antler piece		1
Feature 1	Copper	Bangle piece		1
Feature 1	Iron	Axe head		1
		Knife		1
		Unidentified		4
Feature 1	Glass	Misshapen piece		1
Feature 1	Stone			
	Schist	Knob of lid		1
	Schist	Unidentified		1
	Sandstone	Pestle		2

Table 5: Quantification and description of finds in Period III

Context	Object	Description	Count
Terracotta	Bead	Black	
		Arecanut-shaped	9
		Pear-shaped	1
		Spherical	2
		Red	
		Arecanut-shaped	2
	Marble	Black	3
	Potsherd disc	Red	2
	Gamesman	Black	2
		Red	1
	Reel	Red	1
	Pendant	Black	2
	Lid of vessel	Red	1
	Unidentified	Red	4
Clay	Unidentified	Perforated	1
Iron	Hook		1
	Unidentified		6
Glass	Bead	Transparent, pendant	1
		Black, misshapen	1
	Misshapen piece		3
Stone	Chalcedony?	Pebble + chip	2
	Schist	Unidentified	3

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Marine Archaeological Exploration on the Western Coast, Gulf of Khambhat

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Abstract

Recent exploration along the eastern Saurashtra coast yielded a large number of stone anchors from Gogha, Hatab and Gopnath indicating active maritime activity in the past. The anchors were mostly of the Indo-Arab type and were triangular/ composite in nature. These anchors get exposed during low tide and are submerged under 5 to 8 m water during high tide. A stone anchor from Hathab similar to those found in Chinese waters is made on laterite. These explorations yielded a large quantity of glazed ware from Gogha suggesting that the Indo-Arab type of stone anchors, may be placed within a time bracket ranging from the 9th and the 14th century A.D.

Introduction

The Gulf of Khambhat along the eastern Saurashtra Coast has preserved evidence of the oldest civilization in the subcontinent (Fig. 1). The famous Harappan port town at Lothal is situated at the head of the Gulf of Khambhat (Rao 1979). Other prominent Harappan sites include Padri (Shinde 1992) and Hanuman-no-Timbo (Ghosh 1989) in the estuaries of the river Shetrunji at the entrance of the Gulf. Budhel, another small Harappan site, is situated close to Bhavnagar on a seasonal river which enters the Gulf from the east. Sites of the historical period have been discovered at Vallabhi on the west coast and Hathab on the southwest coast of the Gulf. This region has been vividly described in the Periplus of the Erythrenean Sea dating back to the 1st century A.D. (Schoff 1912). The Vishnu Purana mentions a tidal range of 510 angulas (about 10 m) that closely matches the present-day tides in the Gulf of Khambhat (Pannikar and Srinivas 1971).

Exploration in this area yielded a large number of stone anchors at Gogha, Hatab, and Gopnath. These are similar to those reported from the western coast of the Saurashtra, particularly at Dwarka (Gaur et al. 2001), Bet Dwarka (Sundaresh et al. 2004), Miyani, Visawada (Gaur *et al.* 2007) and Somnath (Gaur et al. 2002). The stone anchors can be used to discover anchoring points in the past, and the size of ships and boats. A large quantity of glazed ware was collected from the inter tidal zone of Gogha along with stone anchors. The date of this glazed ware may range between the 10th and the14th century A.D. This paper discusses results of marine archaeological research in the Gulf of Khambhat, and discusses role of tides in past maritime activities.

Results of Exploration

Exploration along the western coast of the Gulf of Khambhat led to the discovery of several artefacts at Gogha, Hathab, and Sultanpur. Ancient remains of jetties were noticed at Bhavnagar and Sultanpur.

Gogha

The town of Gogha is located on the mid-western coast of the Gulf of Khambhat in the Bhavnagar district of Gujarat. A famous Gujarati proverb *Lankani lari ane Ghoghono var* (Bride of Lanka and groom of Ghogha) hints at direct overseas relations between Gogha and Sri Lanka (Chaukasi 1989: 634). The presence of ancient Jaina temples at Gogha dating back to the 10-11th centuries A.D., suggest that this was a religious centre. The earliest Arabic inscription from Gogha dates to 1170 A.D. (Oza 1885). During the British period ships of up to 1500 tonnes were loaded here (Habib 1982).

The exploration at Gogha was undertaken during low tide and discoveries were photographed and drawn. A large number of stone anchors were recorded between 100 and 200 m from the high water line (Table 1). The majority of anchors belong to the Indo-Arab type (Fig. 2). Nearly 40% are broken. Interestingly, fresh surfaces of broken parts suggests that breakage took place during the manufacturing stage and not during the process of anchoring. A composite anchor made of limestone is another noteworthy find from the site (Fig. 3). A few unfinished anchors (Fig. 4) were also found from Gogha and Hathab. However, these anchors are submerged in 5 to 7 m water depth during high tide. Thus, it indicates that large boats were anchored at this point during high tide. The author of the Periplus of the Erythrean Sea also records that during low tide, boats rest on the seabed.

Exploration in the inter-tidal zone has also yielded several sherds (Table 2) of glazed ware in the vicinity of

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Table1: Details of stone anchors from Gogha

Type of Anchor	Raw Material	Length	Upper Section	Lower Section	Upper Hole	Lower Holes
Grapnnel	Basalt	188	22/23	30/35	8	10x15, 10x15
Grapnnel	Basalt?	140	40/35	50/35	-	18x15, 18x15
Grapnnel	-	220	60/50	70/65	-	30x22, 30x22
Grapnnel	-	155	30/25	40/35	-	22x15, 22x15
Grapnnel	-	175	28/28	40/40	8	-
Grapnnel	-	55	38/30	30	-	-
Grapnnel	-	63	-	35	-	15x10
Grapnnel	-	190	25/25	40/35	5	15x10, 12x10
Grapnnel	-	205	30/25	35/35	-	10x12, 10x12
Grapnnel	-	110	25	35	12	-
Grapnnel	-	105	30	36	-	-
Grapnnel	-	78	34	38/35	-	12x12, 12x12
Grapnnel	Limestone	80	74 width	100 width	9, 10	10x10, 10x10
Grapnnel	Basalt	250	40/40	30/35		25x22, 25x22

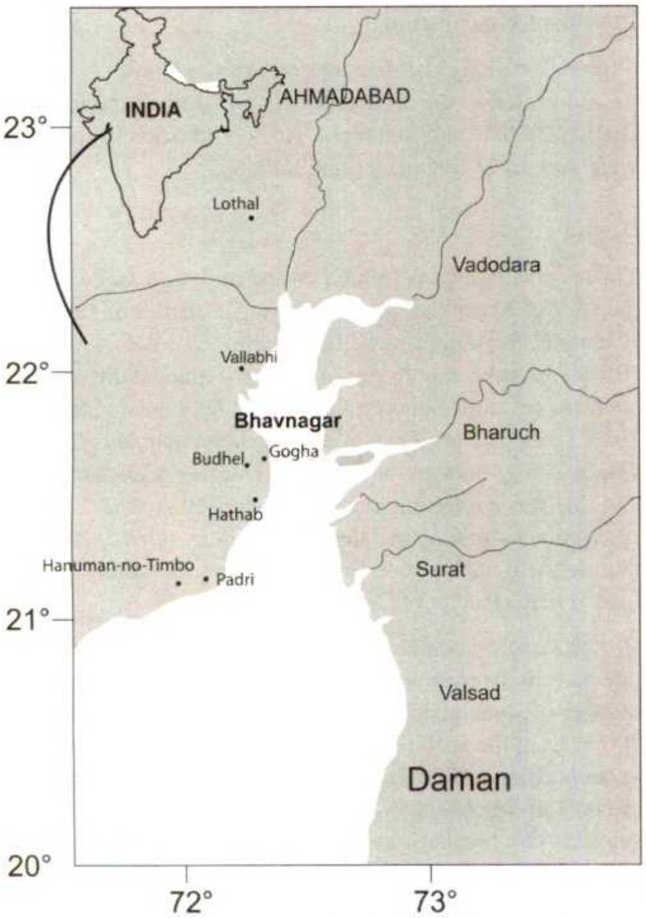

Fig. 1: Important archaeological sites along the Gulf of Khambhat

stone anchors. These include a jar with glazing on the interior and upper half portion on the exterior. The rest of the sherds are glazed only on the interior (Fig. 5). There are three main type of glazed ware, i.e. green, blue and brown. These are similar to the Islamic glazed ware found from various parts of the country (Mohammad 1985; Bhan, 2006)

Hathab

Hathab, an Early Historic site finds mention as Astacampra in the Periplus of the Erythrenean Sea (Schoff 1912). On-shore excavations yielded many antiquities of the historical period and evidence of maritime contact with the West. It is located about 1 km in hinterland. The inter-tidal zone of the site was visited during the lowest low tide and findings were documented. These include two anchors similar to those of the Indo-Arab type, and one anchor with a wide groove around the middle of the anchor. This is very similar to those reported from Japan and China (Fig. 6).

Budhel

Budhel, a late Harappan site is situated about 20 km southwest of Bhavnagar. The site is partially covered with a Muslim graveyard and a part is under cultivation. A small seasonal stream flows close to the mound and merges with the Gulf of Khambhat near Gogha.

Hanuman-no-Timbo

The Harappan site of Hanuman-no-Timbo is situated on an estuary of the river Shetrunji near Sultanpur in Talaja taluka. A modern road divides the site into two. On the western side the mound is higher than that on the eastern side. The site extends approximately over an area of 0.5 x 1 km. The low lying area surrounding the site may be a tidal palaeo- channel (3rd millennium B.C.). A large quantity of pottery including perforated jars, and painted pottery were noticed during the exploration. It was interesting to note that fishing boats can approach the site during high tide (Fig. 7). Thus the site seems to have been an ancient port town of the Harappan period.

Table 2: Pottery recovered from the inter-tidal zone of Gogha

Shape	Type of glaze	Remarks
Plate	Green glazed	Internally glazed and corrugated profile
Plate	Blue glazed	Pitted surface and coarse fabric
Plate	Blue glazed	Internally glazed and corrugated profile
Bowl	Green glazed	Externally wavy lines below the rim. Medium fabric
Basin	Cream slip	Externally seriation marks are noticeable
Basin	Black ware	Small sized vessel. It is ill fired
Jar	Cream slipped	Well fired and medium fabric
Jar	Grey ware	Externally treated with black slip
Surahi	Buff ware	Externally decorated with incised designs
Bowl	Chinese ware	Ring-footed base. Deisgns on both sides
Basin	Grey ware	Externally treated with black colour
Dish	Blue glazed	Ring-footed base.
Bowl	Blue glazed	It has a pedestal base
Bowl	Blue glazed	Ring-footed base. Growth of barnacles noticed
Bowl	Green glazed	Ring-footed base and has a corrugated profile
Dish	Blue glazed	Ring-footed base and has pitted surface
Bowl	Blue glazed	Pedestal base and has a corrugated profile
Dish	Brown glazed	Ring-footed base and has a corrugate profile

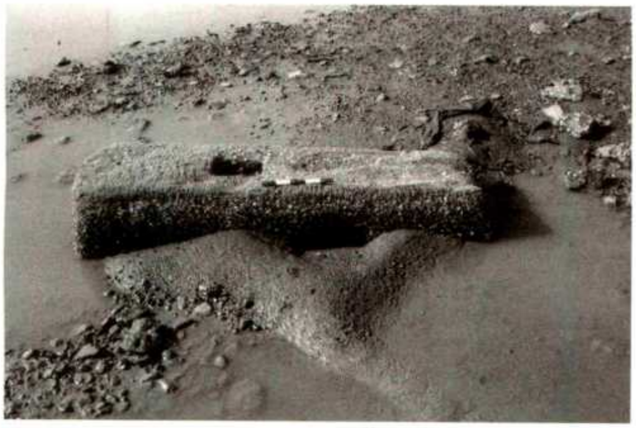

Fig. 2: Indo-Arab type of anchor from Gogha

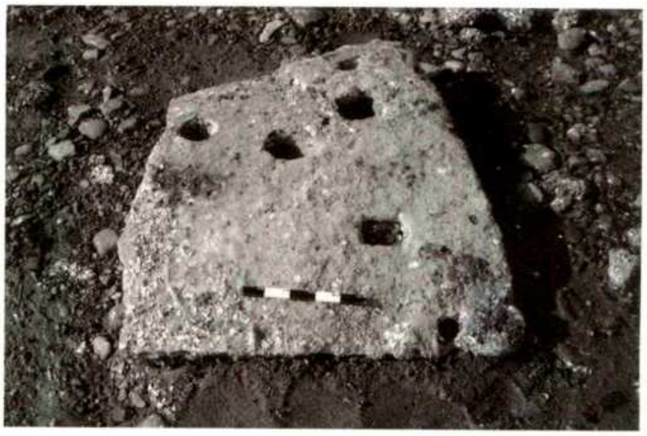

Fig. 3: Composite type of anchor from Gogha

The remains of a jetty were noticed at the mouth of the river Shetrunji near the village Sultanpur. This was primarily a wooden jetty (Fig. 8) now abandoned due to emergence of other ports in the vicinity. As per information received from local residents the jetty was built about 100 years ago and was abandoned in the early 1970s.

Gopnath

Gopnath serves as the entry point to the Gulf of Khambhat. The coast is marked with high cliffs, and rocky and sandy beaches. Being close to the Gulf, the tidal range is very high and a large area gets exposed during low tide. A large number of broken sculptures were noticed in the inter-tidal zone. An Indo-Arab type of stone anchor (Fig. 9) was reported at the lowest water line lying about 2 km offshore. It is exposed during low tide on the new moon day. It is complete (length 2.2 m) and made of hard basaltic rock. It has two lower square holes and upper hole is circular in shape.

Vallabhipur

Vallabhi, one of most famous Universities of ancient India, is situated on a seasonal stream. The river must have been a tidal creek in the past. The ancient site is located on the banks of the Vallabhi river. The present shoreline is about 4 km away from Vallabhipur. According to local tradition, boats could reach the site until a few decades ago, but it is completely silted at present. Local information indicates

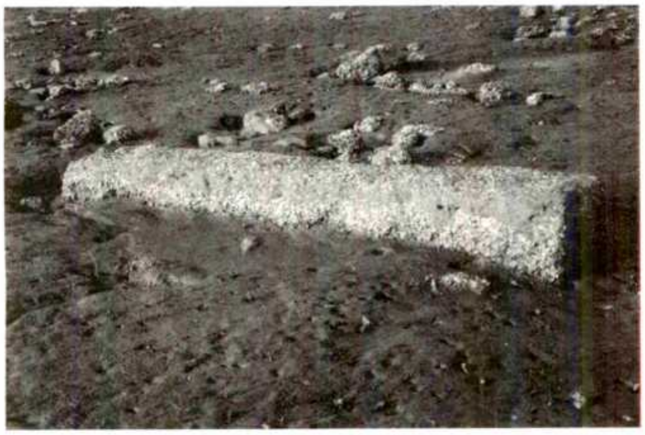

Fig. 4: Unfinished anchor from Gogha

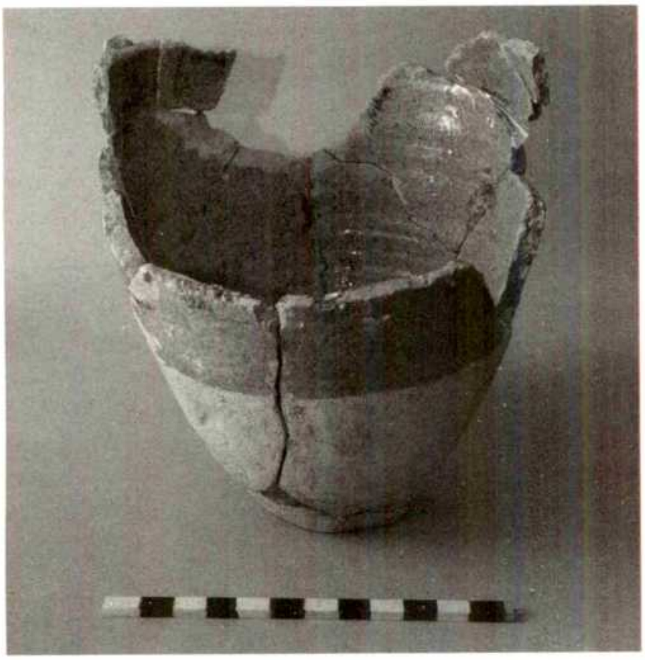

Fig. 5: Glazed ware Jar from Gogha

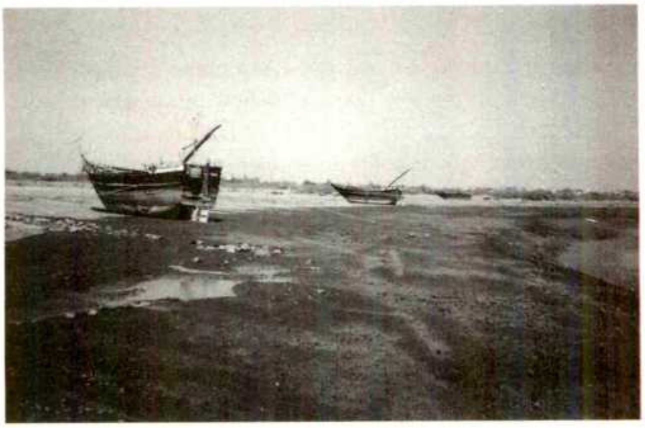

Fig. 7: Fishing boat in the estuary of the river Shetrunji near Hanuman-no-Timbo

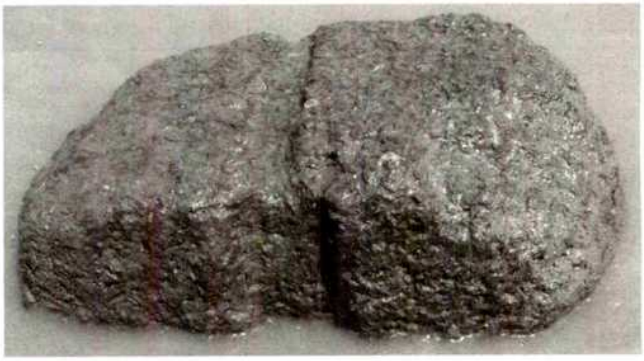

Fig. 6: Chinese type stone anchor from Hathab

that two anchors lay near the present bus stand but were recently shifted to the Taluka office. These two artefacts are channel marker buoys and made of iron (Fig. 10). No information is available on their use and age. However, our observations suggest that these are of the British period and used as channel indicators. Their discovery at Vallabhipur indicates that during the British period ships/ boats sailed up to Vallabhipur, and later the river got silted.

Discussion and Conclusions

The Gulf of Khambhat is famous for a high tidal range which is the second highest in the world with a maximum rise of 11 m on full and new moon days. There is a reference in the Vishnu Purana about the rise of sea level during full moon time up to a height of about 10 m (510 Angulas). The author of the Periplus of the Erythrenean Sea has described the tidal range in the Gulf and difficulties in navigation.

The discovery of a large number of stone anchors from Gogha suggests that it was an important port town during the medieval period. The majority of anchors belong to the Indo-Arab types, dated between the 8th and the 14th century A.D. along the Saurashtra coast (Gaur et al. 2005). Interestingly, for the first time Islamic glazed ware has been collected from the vicinity of the anchors. Gogha was a famous boat building centre during the Mughal Period (Habib 1982). Located at a strategic point on the western coast of the Gulf, Gogha was attacked and captured several times by local rulers such as the Gohel Rajputs. With the emergence of Bhavnagar in the early 19th century, Gogha lost its importance as a major port in the Gulf of Khambhat.

One of the anchors found at Hathab, made on laterite is for the first time from Indian waters. It has a shallow and wide groove on all four faces of the block. It is very similar to those reported from Chinese, Japanese and Korean waters (Yang 1990; Qin Zhang 1989) datable to the 12-14th century A.D. This is the first direct evidence of Indo-Chinese trade during the early medieval period.

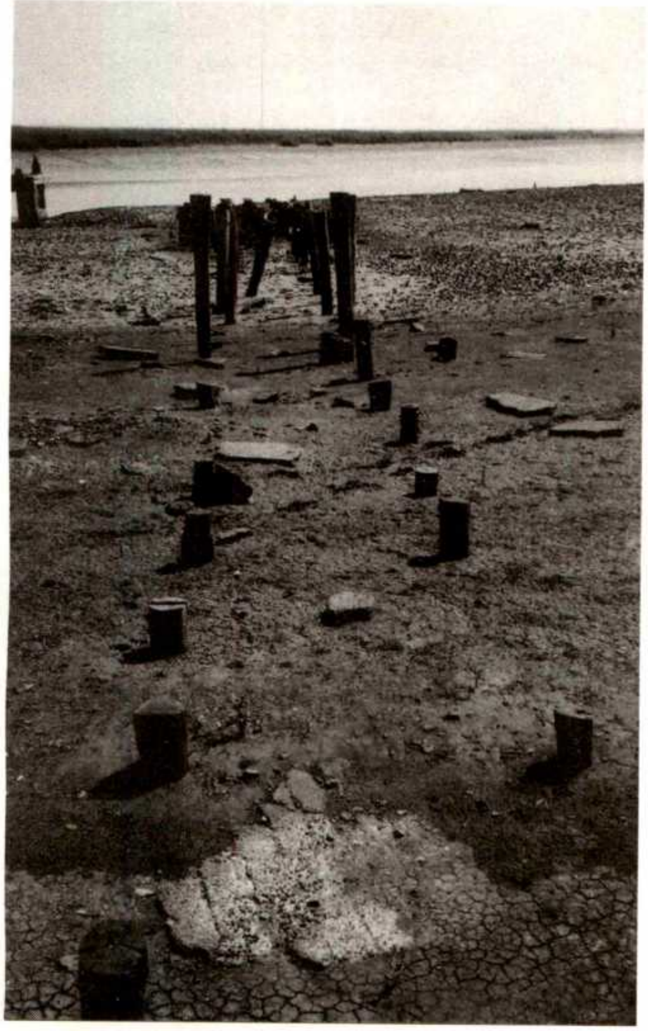

Fig. 8 Remains of a wooden jetty near Sultanpur, Talaja, Bhavnagar

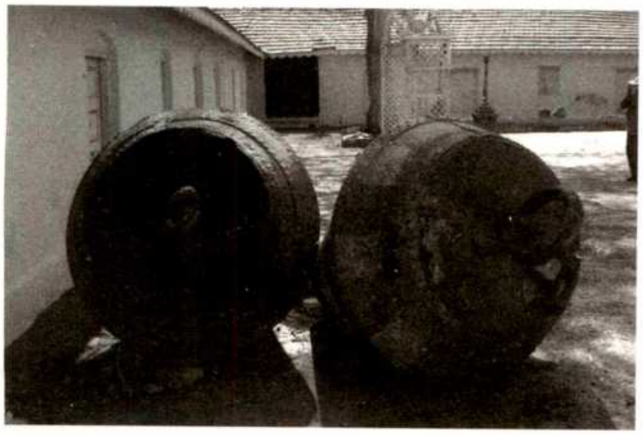

Fig. 10: British Period Channel marker buoys at Vallabhi

Coastal archaeological explorations along the western coast of the Gulf of Khambhat yielded remains beginning from the Harappan times onwards. Budhel and Hanuman-no-Timbo are important Harappan sites situated along the Gulf and Vallabhi and Hathab are noteworthy sites of the historical period. Gogha was the most important port during the medieval period. The tidal range was perhaps the major attraction for a continuous settlement, which facilitates movement of boats without much energy.

Acknowledgements

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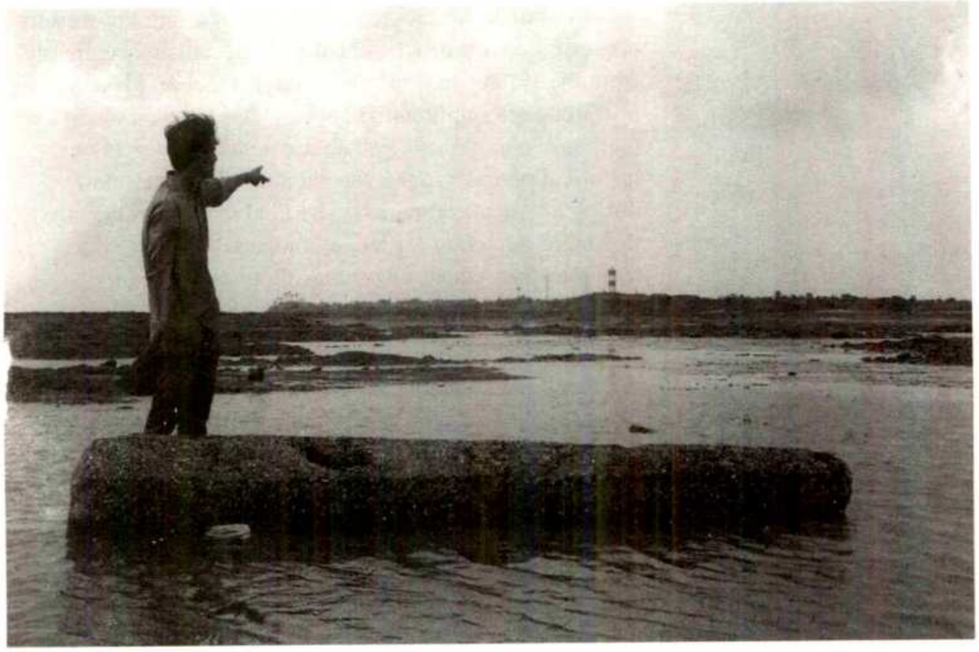

Fig. 9 Indo-Arab type anchor noticed off Gopnath

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Book Reviews

Archaeological Approaches to Technology

Heather Miller

2007. London: Elsevier, Hardcover, Price not given.

I was very happy to read this refreshing account of approaches to the study of technology. For a young scholar like Miller, it is a very mature, incisive and comprehensive treatise on archaeological approaches to the study of technology. She has carried forward the banner of her mentors, Mark Kenoyer and Masimo Vidale, to new heights. Only once in a while one comes across such crisp and cogent writings in archaeological literature.

As far as possible, I would not take the risk of misrepresenting her discourse by putting my words in her mouth; instead, I would allow her cogently and precisely crafted words to explain her approach and concepts.

In chapter 1, she has introduced the terms-production, organisation of production, technology and material culture. Right at the outset, she emphasises the need to study ancient technologies from the perspective of multiple technologies, and not single technologies. It is interesting to note that she uses the process of defining as a way to explore various facets of an issue or problem, so she is perfectly comfortable with shifting and negotiating terminology as she thinks through a topic.

Miller conceptualises technology in the context of an outwardly expanding, nested set of actions and relationships: from production itself, to the organization of the production process, to the entire cultural system of processes and practices associated with production and consumption. In this book, she treats *technological systems* primarily in the broadest sense, to refer to the active system of interconnections between people and objects during the creation of an object, its distribution, and to some extent its use and disposal. Thus according to her, technological systems can be roughly described as the processes and practices associated with production and consumption, from design to discard.

Miller emphasizes that material culture is not the same thing as "objects." Material culture is about *interactions* between people and things, and especially about information encoded in things. This is a sensible perspective for those who define culture as information learned and transmitted to others, consciously or unconsciously, which is at least a portion of most definitions of culture. She describes material culture as the information encoded in and expressed by human use of objects. Whether the meaning conveyed to others is the same as the original meaning intended by the maker or user is a problem, of course, but this is the case for all forms of information communication.

Emphasising the role of archaeology, Miller says the most obvious contribution of archaeology is that of providing a broad perspective, which can either follow a particular society through time or range across many societies. It provides information about the development and acceptance of new objects and new production techniques, and about changes in past economies, social structures, and political organizations in relation to the invention or adoption of technologies.

Marx believed that the means of production (technology) determined the superstructure. But in Chapter 5, turning Marx almost on his head, she reminds that new technological inventions themselves have seldom altered society. Rather, it is the ways in which the society or individuals within it, use and adopt new technologies, that results in social change.

The value of the book lies in bridging the yawning gap between the 'Two Cultures'. Miller explains, "... technology studies build bridges between scholars in different locations, between different disciplines, and between different traditions or approaches. The study of technology in archaeology has been outstandingly international, with the intersection of researchers from different countries working in different world areas and time periods. The use of archaeometric analysis has fostered collaboration with scholars in the sciences, the focus on objects has encouraged interaction with colleagues in the arts, and the importance of technology in both the prehistoric and the historic periods has provided links with researchers in the historical disciplines. Technology studies increasingly cross the divisions between the sciences, social sciences, and humanities".

In Chapter 2, she discusses the methods used in the study of past technologies. In Chapters 3 and 4, Miller deals with the primary production processes for a number of material or end-product categories, including the production of flaked and ground stone; fibres, basketry, and textiles; sculpted organics such as wood, bone, and shell; pottery and other clay-based ceramics; faiences and glasses; and metals.

Chapter 5 and 6 deal with the thematic studies. The thematic studies are organized by process or functional topic rather than material type, including labour organization, economic exchange, value and status markers, religious rituals, technological style, environmental considerations, and consumption demands.

An added significance of Miller's book is that it places the many technological revolutions of recent times (that is, the past few hundred years) in context with the development of new technologies in earlier periods, particularly with respect to their social context. The development of plastics has interesting social parallels from the development of other new materials in earlier time periods. For example as also differences Old World faiences described in Chapter 6, as these materials were used first for ornaments and luxury containers. As explained in Chapter 5, inventions may be known, used, and abandoned, only to be rediscovered in somewhat different forms and widely adopted centuries later, when the economic and social conditions are more appropriate.

Chapter 6 is the most interesting part of her book for Indian readers, as she illustrates her approach by discussing the technologies of the Indus Civilization. She quotes Jarrige and Vidale to explain the Harappan preference of artificial materials to natural ones.

Miller contradicts the common assumption that new materials were first employed for tools or other "utilitarian" applications, stemming from the popular belief that technological invention was all about necessity from a food-procuring, shelter-creating point of view. She says that many of the major classes of artificial materials invented in antiquity were first used for quite different purposes. Miller classifies even religious objects and rituals as "utilitarian" where they pertained directly to the protection of health, food procurement, and fertility for the people who employed them. She is aware of the difficulties and admits that to determine this archaeologically is a challenge, of course, but considering the creative ways that archaeologists have managed to address elusive topics of gender, social status, and ideological belief systems, it is certainly not an impossible task. Twisting Walker's statement, Miller asserts that the primary function of "non-utilitarian" objects, what they *primarily* do, is to convey meaning.

I think she makes a plausible, though a bit controversial, observation that most new artificial materials are first employed to make either religious objects or status-marking objects. She also notes that the later cases of the metals and vitreous materials relate to the marking of status differences, while the earlier uses of fired clay and plaster for ritual uses are found prior to the development of strongly hierarchically ranked societies.

Somehow the Indus Civilisation defies the traditional definition of Civilization. Miller also notes that there is little of the usual archaeological evidence for a ruling elite, either secular or religious: no large temples or palaces, no evidence for a victorious military or an institutional warehousing system, no rich tombs or monumental art. While we do have a few public buildings at Indus sites, like the Great Bath at Mohenjodaro, the Indus "'monumental architecture" is in many ways the city itself. Rather than an impressive palace complex, we seem to have a city made up of decent neighbourhoods, albeit with a range of large to small houses. Long before the Greeks, the people in the Indus region were laying out blocks of housing on a rough grid plan, building large-scale sewage and garbage disposal systems, and creating truly massive perimeter walls around their city neighbourhoods. She notes that Indus art is not monumental but miniature, and it requires a certain level of cultural knowledge to appreciate it, since its value is as much about specialized skill and labour as it is about rare materials.

Description of artefacts is a simpler task but their interpretation is like walking on thin ice. Miller and Vidale have, however, played with the idea that the development of new materials over some three millennia was related to the changing nature of social status, especially I with the development of cities and complex social and political systems. One approach has thus been to examine the relationship between markers of Indus social relations and the development of new materials, particularly the Indus talc-faience complex.

The evidence, they base themselves on, is that around 6000 BCE in the burials at the earliest Indus Valley Tradition site of Mehrgarh, there is an increase in fired talcose beads, which are white in colour, along with the decrease in white shell beads. By the start of the Indus Integration Era around 2600 BCE, shell beads are relatively rare in both burial and non-burial contexts at numerous Indus sites.

Miller explains that this rarity has nothing to do with difficulty of access to the raw material, as shell bangles and other shell objects are quite common. In fact, shell is still the primary material used for bangles for the Harappan Phase Integration Era burials, but bead ornaments are primarily made from talc in various forms. Thus, shell continues to hold ritual value in some forms, but fired talc beads replace shell beads altogether in all contexts. She thinks that this valuation of talc may have to do with its transformative quality, something not possible with shell.

Such vitreous materials require more skill and more specialized knowledge to produce than beads cut from massive talcose stones, particularly with the need to perfect paste and glaze compositions and firing techniques. The new materials also allowed the use of talc and/or quartz powder, and so the use of waste materials and lower quality talc. Miller thinks that this explosion of new materials is thus a brilliant example of the technical virtuosity of the Indus craftspeople, and also provides insights into the Indus society. "Indus technical virtuosity" refers to the striking Indus characteristic of inventing, adopting, modifying, and diffusing complex techniques across the large Indus region. These techniques were not used to create monumental objects or large symbols of religious or secular power, but were used primarily for the production of small ornamental objects, objects that were worn or otherwise displayed. In Miller's opinion, the small size of these ornamental objects did not preclude their social importance, particularly for communicating social roles, and the development and encouragement of Indus technical virtuosity reflects and is a reflection of strategies of social patterning from the fourth through second millennia BCE, or even earlier. Such new materials could be employed to create status symbols for middle-level classes, allowing an extended hierarchy of status in societies ranked with increasing~ complexity.

She places the Indus talc-faience as objects made from materials not so difficult to access, but requiring quite high levels of technological elaboration. These materials range from low to medium difficulty of access, as the talcose stone and quartz minerals needed, were located in several regions around the immediate edges of the Indus Valley, so that they could likely be procured in sufficient amounts in a steady supply through reliable trading connections. But all of these materials involved production processes of many steps and a great deal of specialized knowledge, resulting in a high rating for technological elaboration. This combination made them ideal status markers for the growing middle levels of status in the urbanizing Indus civilization. These ornaments and other display items, made of heat-transformed talcs and/or various faiences, could function as symbols of status for the growing ranks of merchants, workshop owners, and bureaucrats in trade, craft production, and urban management during the Indus Integration Era.

Discussing the relationship between the demand for new artificial materials and the increasing diversification of social and economic classes in the Indus, she realized that it turned out to be rather involved but highly revealing for the Indus, and is especially interesting in light of some unusual aspects of Indus material use in comparison to the contemporaneous early civilizations of the Near East and Egypt, particularly the relative absence of lapis lazuli and the prevalence of talc/steatite.

Extrapolating on Kenoyer's arguments, Vidale and Miller suggested that the many new talc-faience complex materials produced in the Indus region during the third millennium BCE were employed to create status markers for an expanding middle level bureaucracy and socioeconomic elite, along with other objects of low access cost but high technological complexity. This suggestion that new artificial materials of middle overall value were created to provide imitative luxury goods for new middle levels of status, while the highest elite continued to acquire rare natural materials, fits perfectly with the data for red with white beads. But when Miller subsequently began to look more closely at the data for beads made of talcs and faiences, the majority of which were white or blue, this hierarchy of value no longer seemed so clear.

Miller informs us that unlike the red bead assemblages, exotic natural stones of white and blue, such as quartz, white agate, ivory, alabaster, lapis, and to some extent turquoise, were not used to make highly valued beads. This is not a problem of lack of access to the raw materials; these materials were available to Indus people and at least the white materials were often used to make other objects. Instead, white and blue beads made of artificially created materials seem to have been the most highly desired, particularly materials altered or created by very high heat, such as fired tale, talc/steatite microbeads, and the various faiences. These are unlikely to be imitations of rare natural materials, because natural exotics were simply not used, with the possible exception of turquoise, which is found in small quantities and used only to make beads, not seals or other display objects. The blue faiences and glazed materials of the Indus Integration Era are typically light blue to bright, slightly greenish blue, or even "apple-green." The light blue to sky blue glazes, the most common blue colors, are not imitations of any natural stone at all, as no natural materials of these colors are found in the Indus bead assemblages. Most significantly, there are no dark blue glazes or faiences at all during the Indus period; that is, no potential imitations of lapis lazuli.

Miller makes an important observation that the absence or underutilization of rare exotic stones in the Indus is particularly surprising for lapis lazuli, which was so highly valued in contemporaneous Egypt and Mesopotamia. Lapis was available to the Indus people through their trading networks, and their presence in Baluchistan and Afghanistan, most notably at the site of Shortugai in the Oxus region, has been assumed to indicate their interest in acquiring lapis. However, early excavators with experience at Mesopotamian and Egyptian sites of the same period mention the surprising lack of lapis at Indus sites. What little lapis has been found even within the cities of the Indus Valley is often of relatively poor quality. Significantly, at least at Harappa itself, it is not until the very end of the Indus Integration Era that we see the development of cobalt and dark blue, lapis-colored faience.

Steering clear of the attempts to equate the Aryans with the Harappans Miller says, "As a pyrotechnologist, I would like to believe the Indus people valued fire and its uses, but certainly there is no archaeological evidence to show that they held it in religious veneration, beyond the likely veneration of the home hearth typical of most societies in the past to varying degrees".

Miller notes important additional reasons why the development of new artificial materials for display items may have been encouraged in the Indus, beyond their role as a marker of status for new middle-level socioeconomic classes. Particularly for beads and other objects made of white heated talc, the primary use of many new artificial materials seems to be not as markers of social hierarchy, but rather as markers of social unity. The Indus Integration Era, like earlier periods in Mesopotamia, marks a time when new social and political configurations were appearing for the first time. Humans moved into the dense social landscapes of cities, and formed ever-widening social relationships. Larger and more complex political structures were needed to deal with the tensions and complexities required by the increasing heterogeneity of social groupings. New markers of social relationships were thus needed, both to clearly show the developing social and political hierarchies, and to signal general membership in these new social and political organizations. So new symbols of belonging were needed, and new artificial materials offered opportunities as new markers of social and ideological meaning.

Summing up, Miller reports that she found, throughout her research into Indus pyrotechnologies, the Indus craftspeople were extremely technologically innovative in the creation of new materials. This was particularly true for the sintered talcose and siliceous materials, where we see a virtual explosion of new materials during the third millennium BCE, at the same time as the development of the Indus civilization during the Indus Integration Era. In some cases, artificial materials do seem to have been used to make imitations of rare natural materials, apparently to increase the number of status markers in an expanding socioeconomic hierarchy. But in other cases, the relative value hierarchies yielded some surprising results, with artificial materials more highly valued than expected, and not imitating rare natural materials at all. The pyramid of value is truncated for many of the new materials, particularly the talc-faience complex and stoneware, with no rare raw materials used by a high elite. She emphasises that culturally-specific desires and values were more complex than simply a high valuing of exotic rare materials; a number of desired attributes, in some cases overlapping, relate to this development of new materials. Rare natural materials were indeed desired and imitated. But materials transformed in colour and nature by heat seem to also have been highly valued, as were materials of high reflectivity. She thinks that any or all of these categories may be related to Indus ideological systems.

Her concluding chapter discusses the analysis of multiple technologies. In the last chapter, Miller ambitiously discusses the creation of a framework for cross-craft comparisons. She hopes that the use of a systematic framework of analysis will ultimately allow us to see interactions between different groups of craftspeople, as well as provide information about societies in general.

She thinks that cross-craft comparisons can be extremely helpful in assessing relative value, as discussed in Chapter 6, particularly if technological processes may be part of this value. Cross-craft comparisons can also be made across regions, across scales of societies, and across types of social and political organization. After all, the reality of the world, present and past, is of a mosaic of groups interacting with each other, hunter-gatherer groups trading forest products to urban dwellers for pottery or metal, or small fishing villages participating in multi-state exchange networks, so that craft products and perhaps techniques cross geographical and social boundaries every day. Cross-craft technology studies allow a great deal of freedom in comparing groups, and the way they create, adopt, and employ technologies.

Miller's stimulating book gives many new ideas in studying ancient technologies from an archaeological perspective. The Harappans are still an enigma to us mainly because their script has not been deciphered so far. Miller has tried to gain some insights into the social structure and hierarchies of the Indus Civilization through the study of Pyrotechnology. She has been lucky to have been trained by her two very competent and technology-savvy mentors, namely Jonathan Mark Kenoyer and Masumo Vidale. She has given full credit to her Gurus but has taken the Harappan studies in this book to a new height.

The significance of her book lies not only in understanding the Indus Civilization but in the study of the whole gamut of ancient technologies in a broad archaeological perspective. I am sure, all excavators would benefit a great deal from this study. Her seminal work will help us understand the Harappan and the other ancient societies through a broad based study of their technologies. This is a book which is a must for not only archaeologists and historians but also for students of sociology.

This introduction to the way archaeologists approach technology has, Miller concludes, "piqued interest in this fascinating, interconnected, endless field of study. May good journeying through this country be yours, whether you are following paths or blazing them."

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Formation Processes and Indian Archaeology

Paddayya, K., Richa Jhaldiyal and S.G. Deo (Eds.)
2007. Pune : Deccan College. Pages 294, Price: Rs. 500/-

This volume comprises proceedings of the one day seminar on 'Formation Processes' held at Deccan College in December 1999. Subsequently, K. Paddayya, invited several other Indian and foreign scholars to contribute papers on the theme of 'Formation Processes'. The contributions by Lewis Binford, Michael Schiffer and K. Paddayya are very valuable and stimulating. Schiffer and Binford have contested each other's standpoints and approaches. In such eclectic proceedings, it is always difficult to maintain a uniform quality. Moreover, most of the scholars, contributing to the volume, may not be fully conversant with theoretical issues involved in such a theme. If some of the articles seem to be devoid of any insight into the theory of formation processes, they cannot be blamed as Schiffer himself admits that these studies have just begun. I, for one, was quite ignorant of the intricacies of the issues involved and learnt a lot from the three articles of the introductory part of the book. This led to a few academic exchanges with the editor and Schiffer as well. Paddayya deserves full credit for introducing the formation processes approach to Indian archaeology.

The volume has been divided into five parts; the first being introductory. Part II deals with formation processes and prehistoric sites; Part III with protohistoric sites; Part IV with historical and ethnographical contexts; and the last part deals with formation processes and scientific studies. In fact, the most interesting articles are in parts I, IV and V. The first introductory article by Schiffer, assisted by LaMotta, is very informative and educative as it gives a fairly balanced review of the state of art.

Schiffer and LaMotta explain that the overall strategy of the archaeologists rested on the principle that human behaviour and material culture are patterned, and so the archaeological record must also be patterned. From this principle follows the mandate for archaeological analysis: apply patterned discovery statistics to artefacts in the archaeological record and the results will yield archaeological patterns that directly reflect past human behaviour. Schiffer, who had worked under Binford, gradually developed doubts about the merits of New Archaeology's strategy of behavioural inference. Soon, Schiffer found that the attempt of New Archaeologists to directly translate systemic patterns into archaeological patterns was fatally flawed. Schiffer concluded that it was impossible to establish behaviour inferences on a scientific footing, if one assumed away significant sources of variability - formation processes - intervening between systemic pattern and patterns in the archaeological record. This was the beginning for Schiffer to investigate how formation processes transform past behavioural systems into archaeological remains. In this venture Longacre encouraged him.

Schiffer gives many examples of his illuminating studies of formation processes.

Schiffer makes it clear that he is not advocating giving up quantitative methods in archaeology. He says that he is simply presenting a challenge for creating a new quantitative paradigm and a new quantitative technique which rests on sound principles of formation processes. He further suggests that fundamental processes depend on constructing a fully general analytical framework, one that simultaneously handles all supra-formal properties of archaeological artefacts - quantitative, spatial, and relational. He is convinced that nothing less than a replacement of the current paradigm by a fully general one can rescue quantitative archaeology from its unscientific state. Schiffer admits that the systematic study of formation process under the umbrella of behavioural archaeology remains at an early stage of development. He confesses that 30 years after writing the first draft of his "Archaeological Context and Systemic Contexts", a scientific archaeology, based on the rigorous consideration of formation processes in every inference, has rarely begun.

Equally interesting is the article by Binford, the propounder of New Archaeology. In the 1950s, Binford started by arguing against the simple conventions to interpret the archaeological record in historical terms. He says that it is important to remember that in the 1950s discovery rather than explanation drove archaeological research. According to him, energy budgets are not responsive directly to ideas; labour and work intervene between ideas and modifications in material entities, including the earth itself. Even more importantly, cultural systems may be at least partially organized in cultural terms but they do not work without an energy budget and they cannot be organized in ways that violate the energy constraints on the system itself. In short, they are socio-cultural systems and, as such, are materialist systems.

Binford also reports some interesting observations made by him during his ethnographic fieldwork with the Nunamiut Eskimo.

He also makes an important observation that all observable variability among archaeological remains was not accurately referable to either temporal change in culture, culture area differentiation in space, or to the migration of cultures over time or across space.

Binford emphasizes that since the early days of the New Archaeology, the study of the formation processes has taken an important role among archaeologists. He further asserts that all of the preceding issues made it clear to processual archaeologists that the questions and observations justifying research on formation processes insured that there would be major problems establishing secure linkages between small-scale temporal or spatial differentiation in past dynamics and their effect on the static remains observed by archaeologists. The recognition of the static consequences of sequence and the differentiation, in both space and time of actions and activities in the archaeological record, were clearly problems about which anthropology and history were mute. No one studied the archaeological record except archaeologists. It was also apparent that archaeologists needed to reject Taylor's view that they were simply technicians who were dependent upon other disciplines to explain the facts of the archaeological record. Those other disciplines did not have to solve the problem of the linkage between stasis and dynamics. They did not have to solve the problem of how initial conditions and subsequent decision making might condition different outcomes in both the form and pattern of debris production in, for example, different lithic reduction sequences. Archaeology had to become the science of the archaeological record if it expected to make reliable inferences about the past.

According to Binford, to make archaeology the science of archaeological records which can produce reliable inferences of the past it was necessary to concentrate on: development of better field techniques, ethnoarchaeological research, experimental research, and a vastly improved capability to produce and analyze data as the goals for transforming archaeology into a knowledge-producing science of the archaeological record.

Criticizing Schiffer's book, *Formation Processes of the Archeological Record* (1987), Binford complains that the book contains very little of relevance to important formation processes, instead it develops two distinct view points: "Item History Approach" and the approaches which focus on the processes that distort the material consequences of a formally living system after the systemic events forming the record of that system which is no longer active.

Binford pleads that the issue of referral arguments and their accuracy is not solved by "correcting" the archaeological record and I disagree with Schiffer that archaeologists can correct for distortional processes and then reconstruct an archaeological record that is, by implication, accurately readable. And, even if one could "correct" the archaeological record, the problem of making accurate referral arguments still remains.

Binford concludes that the science of archaeology is not a discipline of technicians, as Taylor suggested. It is an independent anthropological science facing the task of understanding the relationships between the dynamics of a living system and the static restructuring of matter created by that system. As with all historical phenomena, there is entropy in the information and the structure originally created by the living systems. We must learn how to differentially organize our observations on the archaeological record in order to control for both structuring and restructuring processes.

Binford laments till date, unfortunately, most research has been directed toward the restructuring side. It is time for archaeologists to make a concerted effort to understand how human systems of various organizational forms differentially generate structured archaeological remains. To succeed in this endeavour, archaeologists must be informed about initial conditions in order to make the best use of their increasing knowledge about restructuring processes.

What I liked most, however, was the essay by Paddayya, "Role of Formation Processes in Indian Archaeology". For one, one seldom comes across such beautifully written prose in Indian archaeological writings. Paddayya pleads for a broad based methodological framework which should include:- (a) use of analogy taken from experimental/ ethnological studies; (b) ethnological parallels about the influence of natural processes on archaeological record; (c) clues as provided by literary records, oral traditions; (d) and clues as provided by scientific archaeology including bio-molecular studies. More importantly, Paddayya gives an historical outline of the theoretical developments in this field. I am sure, this article needs to be read carefully by all practising archaeologists.

Among others, the essays by Richa Jhaldayal, Carla Silopoli, P.P. Joglekar and Steven Weber are very significant contributions in their respective fields. The other interesting papers included in this volume are by B. Basak, Vidula Jayaswal, J.N. Pal, P. Ajitprasad, P. Vijaya Prakash, Bilal Khirasat, G.L. Possehl, V. S. Shinde and Ritu Mehrotra, Luann Wansnider, Michael Petraglia and Dennis Knepper, G.L. Badam, Arati Deshpande-Mukherjee, Dorian Fuller and Steven Weber, S.P. Eksambekar and M.D. Kajale, Deotare and others, and Sushama G. Deo.

This stimulating volume, I am sure, will prove a must for all field workers trying to make sense of their data from archaeological excavations.

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Harappan Architecture and Civil Engineering

Jagat Pati Joshi

2008. New Delhi: Rupa & Co., Pages 218, Price not stated.

The Infinity Foundation established by Sri Rajiv Malhotra, an NRI settled in USA, deserves our profuse thanks for undertaking publication of this series of books on India's contribution to Science and Technology in which three volumes have appeared. One is the book under review and the other two are on iron technology. As Malhotra states in his introductory note, India was on the same level or rather technologically superior to the west before the industrial revolution in the 18th century, but started lagging behind as it was deliberately suppressed by colonial rulers. It is therefore necessary to demonstrate to the world our contribution, as seen in Joseph Needham's work on China and Forbes' on Egypt.

The book under review by J.P. Joshi, is a welcome contribution, which highlights the achievement of the Harappans in architecture and civil engineering. The author is a recognised authority on Harappan archaeology, and has excavated some important sites in Punjab, Rajasthan and Gujarat. The study is divided into ten chapters of which the first describes the history of discovery of Harappan sites followed by an account of protohistoric cultures. Chapter 3 on settlement patterns, gives a description of important Harappan sites. The most distinguishing feature of Harappan architecture is its town planning (Chapter 4). The author has followed Wheeler and emphasised the division of Harappan cities into a citadel and a lower town. However, it is now becoming evident that there was a four-fold division which is very clear at Dholavira, Mohenjo-daro (Citadel vs DK and HR areas), and Harappa (citadel, mound E, F and area G). At Kalibangan as well as at Chanhu-daro, there are three locations and a habitation besides the fortification walls. This division is of crucial importance in as much as it has a great bearing on the social organisation of the Harappans. A similar division has been clearly identified at Altyn Depe in Turkmenistan where the architecture highlights social organisation. As a matter of fact, this is better observed at Mohenjo-daro, which was a brand new metropolis like New Delhi and Chandigarh, and which did not evolve from the preceding Early Harappan towns. Such work can be done very fruitfully on sites like Rakhigadhi, which was one of the largest Harappan towns.

The Harappan genius is reflected in their hydraulic engineering which was of utmost importance in the semi-arid zone of Harappan urbanization; and hence they have rightly been described as 'master hydraulic engineers'. At Mohenjo-daro, we are told that every third house had a well for water. Proper arrangement for drawing water was in place, and well irrigation was also in vogue. An elaborate drainage system is evident from an underground drainage system for which they invented the corbelled arch, so large that even a man could walk through for cleaning. Perhaps the most elaborate water harvesting system with large reservoirs has been uncovered at Dholavira with a series of check dams, without which such a metropolis would not have survived in this arid region.

Harappan architecture is exemplified by its monumental buildings of baked brick walls built in the unique headers and stretchees fashion which was possible because of their standard size in the ratio of 4:2:1. The houses generally conform to the *Chatuhsala* plan with rooms around an open courtyard, which afforded safety and security to residents. The multi-roomed and storied mansions had tiled floors and paved baths. The average house was about 100-200 m^2 in size, which favourably compares with upper middle class apartments of our own times. The HR area in the southern part of the lower town of Mohenjo-daro was probably occupied by the elite with elegant storied mansions, extending to 300 m^2 ' some of which contained jewellery hoards.

This meticulous town planning was possible because of their knowledge of geometry, particularly mensuration. They had scales, weights and measures based on the decimal system and instruments some of which have been recovered from excavations such as the compass for measuring angles. Gypsum cement was used for building and bitumen for waterproofing.

The author has given a succinct account of Harappan architecture and its technology, but some of the statements cannot be accepted. The Mohenjo-daro bath cannot be an observatory (p. 161) as suggested by him. It is possible that it is a *pushakarni* for ritual bathing. Similarly a plough cannot have a copper plough share. Actually the wooden plough of *khair* (*Acacia catecu*) is still in use in urban India. The volume is lavishly printed on art paper and profusely illustrated but the half tones could have been better.

The sponsors of the series have done a great service to uncover the past glory of India for which they deserve our gratitude. We now look forward to the following volumes, which are being meticulously planned by Prof. D P Agrawal.

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The Central Narmada Valley – A Study in Palaeontology and Allied Aspects

G.L. Badam

2007. New Delhi, IGRMS, Bhopal and D.K Printworld, Price: Rs. 1600/-

The book is an outcome of the studies carried out by the author and his associates in the central Narmada Valley District Narsinghpur, Madhya Pradesh, from 1992 to 1994 under the project "Taphonomy and Palaeoecology of the vertebrates from central Narmada valley". The project was sponsored by Indira Gandhi Rashtriya Manav Sangrahalaya, Bhopal.

Large numbers of vertebrate fossils were collected during the IGRMS project. Systematic palaeontology including morphological description, geographical distribution, evolution, taphonomy and ecology of some of the vertebrate fossils form the major content of the book. Some of the vertebrate fossils whose systematics are described are *Hexaprotodon palaeindicus, Bibos gaurus, Bos namadicus, Bubalus palaeindicus, Axis axis, Antilope cervicapra, Elephas hysudricus, Elephas namadicus, Stegodon insignis ganesa, Hexaprotodon namadicus, Crocodylus palaeindicus, Panthera* and turtle.

The main conclusions of the investigation are as follows: *Sus namadicus, Hexaprotodon namadicus and Elephas namadicus* form the index fossils of the Middle Pleistocene in the Narmada Valley. Some workers (Biswas 1998) however, consider that *Hippopotamus namadicus* (Biswas and Dassarma 1984), *Sus namadicus* (Pilgrim 1926), *Equus namadicus* (Biswas 1988), *Stegodon namadicus* and *Cuon alpinus tripathi*(Biswas and Basu 1997) are representative of the Middle Pleistocene in the Narmada Valley. Micro vertebrates referable to genera *Tatera, Gerbillus, Bandicota* and *Millardia* are reported for the first time from the Narmada Valley. Most of the fossils are not autochthonous. The abundance of *Hippopotamus* suggests prevalence of a swampy pool environment.

Informal stratigraphic units derived by the author are: a. reddish brown calcareous silt and cemented gravel with Middle to Late Pleistocene fauna and the Lower to Middle Palaeolithic tools (40,000 to 150,000 BP), b. yellowish brown calcareous sand and gravel with Upper Pleistocene fauna and Middle Palaeolithic tools (15,000 to 40,000 BP), c. reddish clay band with Upper Palaeolithic tools (10,000 to 15,000 BP) and d. dark brown silt and gravel with semi-mineralized bones and Mesolithic tools (4000 to 15000 BP). Numerous fossils have been collected from the central Narmada Valley from the time of Theobold (1860) till date by government agencies, educational institutions and private individuals. However, most of these fossils still remain unattended and need proper systematic studies. Therefore, these studies dicussed here are important. Micropalaeontology is another area where almost no work has been attempted so far in the Narmada Valley. Micropalaeontological studies started under this project are welcome. The book will be useful to all researchers specialising in Quaternary palaeontology.

I take this opportunity to clear some of the points on the Quaternary geology of the Narmada Valley. The first issue is the term Central Narmada Valley itself which has a definite geological meaning. It refers to that part of the Narmada Valley which lies between Jabalpur and Harda, confined by two deep regional faults. These are Son-Narmada North Fault (SNNF) and Son-Narmada South Fault (SNSF) which limit the northern and southern boundaries of the valley. It is the SNSF which has been active throughout the Quaternary period and which has controlled much of the Quaternary sedimentation in the valley. SNSF is active even now as can be judged by present seismic activity occuring along it. The second issue is the thickness of Narmada Valley Quaternary deposits. The regional Quaternary tectonic scenario features in this part include the Satpura horst flanked by at least two tectonic basins related to reactivation of SNSF (Central Narmada Valley) in the north and two tectonic basins (Tapti and Purna) in the south. These relate to reactivations of the South Satpura Fault and the Achalpur Fault. Quaternary sedimentary thicknesses in all these basins are around 300 m. On the up stream and down stream extensions of the Central Narmada Valley, the thickness remains less than 30 m or so. The third point is that not all the Quaternary sediments in the Narmada Valley are riverine. Fluvial sediments form only a small proportion whereas a major part of the sediments are lacustrine. The Central Narmada Valley had extensively lateritised valley flats at the beginning of the Quaternary. Reactivation of SNSF created two basins separated by a north- south lateritic land corridor running through Hoshangabad. Deeper parts of the basins were located closer to SNSF. Middle Pleistocene sediments in the deeper part are very thick (more than 100 m) comprising steel grey and yellow clays. Only Upper Pleistocene and younger sediments are riverine. I may add that the lithostratigraphic formation are based only on the lithological characters and are time independent. Palaeontological and archaeological attributes should be very precisely shown within a formal lithostratigraphic framework. All the physical attributes may then be continuously compared among themselves as well as with abstract time attributes coming from various sources.

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Arikamedu: Its Place in the Ancient Rome – India Contacts

S. Suresh

2007. Delhi: Embassy of Italy, Pages 126.

In this book, Sethuraman Suresh has compiled available data on Arikamedu and other equally significant, lesser-known ancient trade sites in Puducherry and Tamil Nadu. Several ports have been surveyed and excavated along the east coast of India, but not a single comprehensive monograph covering the archaeological and historical aspects of a particular site has been published, except some excavation reports, such as the Arikamedu Excavation Reports by Vimala Begley *et al.* (1996, 2004). Suresh's present monograph is thus a unique and pioneering attempt and adds a new dimension to the study of Arikamedu.

The book is divided into five chapters followed by appendices, glossary and bibliography. In the first chapter, the author provides a historical overview of the trade between ancient Rome and India. Tamil and Roman literary sources, numismatic evidence and Indian artefacts reported in Africa and the Arabia-Persia regions are discussed. Further, the causes for decline of the trade and its subsequent impact on both Rome and India have also been deliberated.

Chapter 2 deals with trade routes. Here, the author has described the Silk Route, the sea route between the Mediterranean Sea and southern India through the Red Sea, use of monsoon winds by the mariners, trade routes within the Indian subcontinent and finally, the routes between India and Sri Lanka. Interestingly, the distribution pattern and chronology of the Roman coins and other Roman antiquities in South India and Sri Lanka confirms the use of many trade routes in these regions.

The archaeology and history of Arikamedu has been covered in chapter 3. The author has discussed the location of, and approach to the site, and has put forth various suggestions pertaining to the literal meaning of the name 'Arikamedu'. The site has been excavated by several scholars at different times. The Madras Museum excavated the site in 1940 (directed by A. Aiyappan). The French scholars Brother L. Faucheux and R. Surleau excavated it between 1941 and 1944. R.E.M. Wheeler excavated Arikamedu in 1945. Between 1947 and 1950 Casal has conducted excavations here. More recently, Vimala Begley excavated the site between 1989 and 1992. Prior to these excavations, Arikamedu has been described in certain travel accounts. For example, Guillaume Le Gentil, the French astronomer, observed several brick walls, terracotta ring wells and various types of pottery at the site during his visit, between 1768 and 1771. Further, the site has been referred by Jouveau-Dubreuil in 1937 and M. Goloubew in 1939. Finds from Arikamedu are now scattered in various museums and institutes in India and abroad and some are even in private collections. Investigating the antiquity of Arikamedu, the author concludes that trade contacts with the Mediterranean region began in the late 3rd century B.C. and the site was under continuous occupation till the end of the 18th century.

Chapter 4 is focuses on the author's recent field studies in the ancient satellite settlements around Arikamedu. Before the beginning of South India's maritime trade with the Roman world, many sites in the surrounding region were inhabited by the Megalithic people. Such sites include Parikal, Sengamedu, Suttukeni and Tiruvakkarai. Arikamedu had commercial and cultural contacts with these sites. During the period of Roman trade, the main ports along the Coromandel Coast were Vasavasamudram, Karaikadu, Kaveripattinam, Alagankulam and Korkai, with which Arikamedu interacted. The chapter concludes with details of the location of the sites, and the finds revealed by explorations and digs in each of these satellite sites. Such finds include Roman amphorae, Rouletted ware, beads, jars, terracotta ring wells, brick structures and coins.

The last chapter has been devoted to recommendations. The author has discussed, how Arikamedu is historically very different from all the other sites. The chapter also details the present physical condition of Arikamedu and the natural and manmade threats to the site. The final section of the chapter provides suggestions for developing Arikamedu as an archaeological tourism destination. Presently, the Chennai Chapter of the Indian National Trust for Art and Cultural Heritage (INTACH) is organizing tours, for serious tourists and students, to Arikamedu as part of a bigger 'Roman Trail Tour' of South India.

Appendix-I lists the Roman coin finds at spots in Kerala, Puducherry and Tamil Nadu and Appendix-II lists the amphorae find sites in the same region. This is followed by a useful glossary of some of the rarer and non-English terms used in this book. At the end, there are two bibliographies: Bibliography - I related to the ancient Rome-India contacts and Bibliography - II exclusively covering works directly relating or referring to Arikamedu.

The book is an essential addition to the existing literature on the maritime trade contacts of India. Well-illustrated and attractively produced, the book will be useful to students, researchers and all others interested in ancient trade and Arikamedu. (This is NIO Contribution No. 4467).

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Conference Reports

Not Only Food: the Second Meeting of the ICAZ Archaeomalacology Working Group at Santander in Spain (19-22 February, 2008)

This report deals with the second meeting of the ICAZ Archaeomalacology Working Group at Santander in Spain between 19-22 February 2008*. The Archaeomalacology Working Group was formed during the ICAZ conference at Durham UK. in 2002. In the previous ICAZ meetings, it was observed that majority of the paper presentations had focused on vertebrate animals. Studies regarding those of birds, fish and reptilian remains were also emphasized, whereas those on molluscan shells received less attention. It was because of this reason, thanks to the efforts of Dr. Daniella Bar Yosef and a few others, that the idea of forming a working group with a common interest in archaeological shells took shape at Durham in 2002. Since then, after its success at Gainesville in Florida and recently at the ICAZ in Mexico 2006 it has a formed an ideal platform for archeomalacologist from world over with a wide membership of more than 200 members, a web site and a newsletter.

The Second Meeting of the ICAZ Archaeomalacology Working Group Congress was organized by Dr. Esteban Alvarez Fernandes (Instituto Internacional de Investigaciones Prehistoricas de Cantabria) and Diana R. Carvajal Conteras (University of Calgary). It was held at Santander, an old port town located in northern Spain on the Cantabria coast overlooking the Atlantic Ocean. The venue was the Salon de Actos, Escuela Tecnica Superior de Nautica (University of Cantabria) Santander. The congress was inaugurated with the opening lecture by Pablo Arais, (Director of the Instituto Internacional de Investigaciones prehistoricas de Cantabria (IIIPC) titled *Altamira and much more! An overview of the prehistory of Cantabrian Spain*. Following this for the next two days a total of 33 papers were presented including both oral and posters along with discussions at the session end. The theme being 'not only food' topics ranged on shells from Palaeolithic sites to as late as the 1891-1950 US shell button industry. Regions under consideration varied from the Aleutian Islands, Lake Baikal in Siberia, Britain, the Mediterranean region, Syria, Israel, and India with a wider representation from the Central and South American countries like Mexico, Puerto Rico, Argentina, Columbia, Panama and Uruguay. Diverse aspects like shell taphonomy, technology, shell bead manufacture, purple dye extraction, new approaches to radio carbon dating,

Fig. 1: Iron Age site at Pena Tu

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* Participation in the conference was made possible through the Foreign Travel Grant (FTG) provided by the Indian Council for Historical Research (ICHR). I am greatly to the ICHR.

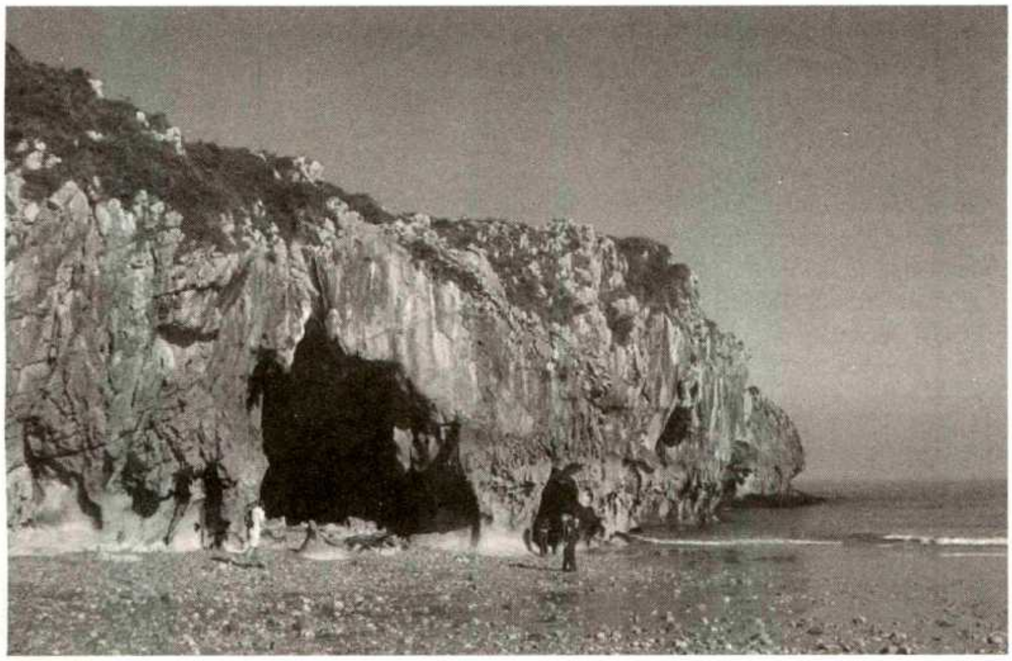

Fig. 2: Cuevas de El Mar – A coastal Mesolithic cave midden site

paleoenvironment, oxygen isotope analysis, dietary use, symbolism, etc. were discussed. Most interesting were the reporting of worked marine shells from the Upper Palaeolithic, Mesolithic and Neolithic sites in Scotland, Spain, France, Israel, etc. The sessions ended with a wine reception hosted by the Mayor of Santander for all the members at the Palacio de la Magadalena.

Following this two days of field visits to some of the world's most important prehistoric sites in the Asturias were also organized. The Asturias region constitutes a beautiful, picturesque undulating landscape with limestone mountains, green valleys, beaches and a rocky coastal zone. It is also a region which has produced a large number of sites ranging from the Palaeolithic, Mesolithic, Neolithic, Iron Age and medieval periods. An interesting feature of these sites is the evidence for the exploitation of marine molluscs in the form of shell middens. The Asturian Mesolithic shell midden sites of El Toralete (Santiuste Asturias) and Cuevas de El Mar were visited which are located in limestone caves. The latter are a series of caves located on a beach at the mouth of the river Nueva which had been discovered in 1916 by count Vega del Sella (Fig. 1). At these caves marine shells of *Patella vulgata* occur along with lithics and animal bones. Palaeolithic rock art was seen at two sites Tito Bustillo and Pena Tu. The Tito Bustillo is one of a group of lime stone caves located in the Ardines Hill. This is a large cave with winding chambers covered with stalactites and stalagmites. Excavations have yielded an Upper Palaeolithic occupation. Paintings of horse, bison, reindeer, and female anthropomorphs using red ochre, charcoal and a purple pigment are seen on the walls. Most famous are the gallery of horses in different position, sizes and movements. The rock art site of Pena Tu is situated 165 m above sea level and only a few kilometres from the coast. The panel with artistic depictions is situated in a hollow on the eastern face of a large rock outcrop which stands out as an isolated block at the western end of the Sierra Plana de Vidiago (Fig. 2)

The famous Altamira cave site was visited although it was the replica which is open to public yet gave the same exhilaration which one would have felt while seeing the original. The ceiling recreated with many paintings of bison was spectacular. Located close to Altamira is the medieval village of Santillana del Mar which has retained its old wooden houses with balconies and cobbled streets. The field visits gave an excellent opportunity to see some of these important prehistoric sites of Spain as well as the region. A visit was also organized to the Prehistoric Museum in Santander where one is able to see some of the fine engraved and modified animal bones of the Upper Palaeolithic period along with lithics and ceramic assemblages. The conference came to an end with a banquet dinner at the Restaurante del Museo Maritimo del Cantabrico in Sanatander. The overall informal but intense academic atmosphere along with the warm hospitable nature of the organizers made the meeting a large success. The working group is hoping to meet at the next ICAZ in Paris 2010.

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Training Seminar on 'Technologique de la Pierre prehistorique et experimentation' at Les-Eyzies-de-Tayac, France

Lithic experimentation is a powerful way in which to understand stone tool technology. I had the opportunity to attend a training workshop; "Technologique de la Pierre prehistorique et experimentation" at Les-Eyzies-de-Tayac, organized by CNRS-UMR 5199(IPGQ), University de Bordeaux, from 23rd September to 2nd October, 2008. Les Eyzies is a small town in the Dordogne valley, which constitutes an important centre for prehistoric sites including those renowned for their rock art.

The workshop was organized by Profs. P.-J.Texier, J.-G. Bordes and J.Pelegrin, and included lectures by these scholars along with those by L. Meignen, S. Maury, L. Klaric, A.Turq, V. Lea, and M.Brunet. These lectures provided for an intensive workshop which covered theoretical and experimental issues related to lithic technology, ranging from the Lower Palaeolithic to Neolithic. Only 23 selected participants from Germany. Belgium, Bulgaria, Ukraine, France, Mexico, Syria, India, Iran, Italy, and the USA participated. Participants were selected, primarily on the basis of their research interests and proposals, so as to enable them to utilize the knowledge gained from this course in their ongoing projects.

The workshop which began at 9 am and ended at 7.30 pm, every day; was divided into three parts: a) theoretical issues in lithic technology (lectures, powerpoint presentations, videos) b)observation and study of collections from different parts of the world; c)lithic experimentation.

The topics covered included an introduction to lithic technology and fracture patterns, overview of techniques used during the Pleistocene and Holocene and introduction to techniques used during the Lower Palaeolithic. This was followed by lectures on Mousterian, non-Levallois and blade techniques. Detailed lectures on the concept of Levallois followed, as also in-depth studies of various blade techniques used during the Upper Palaeolithic. The course also highlighted techniques used in the Mesolithic and Neolithic.

The experimental studies were the most important part of the course. The trainees were provided with abundant raw material, stone, bone and wood hammers and leather aprons. Following a demonstration, trainees began knapping and were guided by experts. At the end of each day, it was possible for a skilled student to produce tools which were the focus of the day. Thus, handaxes, Levallois flakes, and blades could be produced by trainees, including those who were beginners. Further, the course allowed the student to make a study of the cores and waste products in the reduction sequence, thus obtaining a better perspective of the technological strategies involved. Individual attention was given to all the participants during the course. Apart from flint we were given the opportunity to work with obsidian. Although the course was in French, care was taken to explain finer points in English and discussions often carried on till late at night.

In addition to the course, the organizers planned an excellent two day field visit to see world famous prehistoric sites, many of which are famous for their rock art:- Abri Pataud, La Moustier, La Ferrassie, La Micoque, Laugerie-Haute, Font de Gaume, Le Cap Blanc and Rouffignac cave. Ongoing excavations at Abri Pataud were also notable. In particular, Rouffignac with its incredible depictions of mammoths and the sculptures of Le Cap Blanc, are a must for any student of prehistory and rock art. The conservation of these sites as well as the importance accorded to prehistory and rock art, was indeed

Fig. 1: Lithic knapping in progress at the training seminar

Fig. 2: Visit to Laugerie Haute

notable. The Prehistory Museum at Les Eyzies was a memorable experience on how to make the subject of prehistory interesting for the community. A dinner at the medieval site of Sarlat was also an experience to remember.

The course was not only marked by the excellent quality of teaching and guidance, but also by the hospitality and friendliness of the organizers. From the excellence of the course, to accommodation and food; and the splendour of the Dordogne countryside-this seminar was an experience of a lifetime.

Understanding reduction sequences through experimentation has been neglected greatly in India, and this course enabled the author to begin similar studies with respect to assemblages which are being studied from excavations at Attirampakkam.

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International Workshop on Use of Remote Sensing and Other Scientific Techniques in the Archaeology of Asia (October 2, 2008, BHU, Varanasi)

The workshop was chaired by Mrs. Anshu Vaish, Director General, ASI and jointly coordinated by Prof. Vidula Jayaswal (BHU) and Prof. Himanshu Prabha Ray (JNU). It was aimed to provide a platform for discussion of recent trends in archaeology and the increasing use of scientific tools and techniques in addressing issues of wider social and cultural relevance. It brought together researchers and scholars from several premier institutions of India, such as the Archaeological Survey of India, the Indian Institute of Technology, Kanpur, Jawaharlal Nehru University, New Delhi and the Banaras Hindu University, Varanasi, along with scholars from Peking University, China, Termez State University, Uzbekistan and College de France, Paris to promote interdisciplinary dialogue, especially in the context of cultural networks of Asia.

The participants presented their ongoing work on themes ranging from survey work at Chanderi in Madhya Pradesh to geoarchaeological analysis at Varanasi, use of remote sensing images of the Early Chalukyan temples in the Malaprabha Valley, new archaeological discoveries at the Longmen Caves, Louyang, China and the Buddhist monastery at Fayaztepe in Uzbekistan. In addition, there were presentations on the use of high density data collection at the brick temple of Bhitargaon, the use of Geoinformatics and CRM at the archaeological site of Ahichhatra and the application of Ground Penetrating Radar and other scientific tools at the already excavated site of Lothal. It was evident at the workshop that scholars use satellite images and Geographical Information Systems (GIS) in a variety of ways, from building spatially referenced databases to using it as a visualisation tool or for developing analytical frameworks. In that sense the workshop fulfilled its objectives of initiating discussion and sharing of knowledge among some of the stakeholders in the study and research of the cultural heritage. A second objective of the workshop was to reach consensus on continuing the dialogue between ASI and universities and other teaching institutions and also to follow-up this initial endeavour with further meetings. As pointed out by DG, ASI, other stakeholders, such as the State Departments of Archaeology or research scholars also need to be taken into account and the attempt should be to foster a climate of cooperation, debate and discussion. Several models could perhaps be explored, such as involving universities in the study of heritage sites or perhaps undertaking joint research projects. There was unanimity on two counts: first, that the papers from the workshop should be published to provide a basis for further discussion; and secondly, that similar meetings were to be encouraged so that the dialogue could continue.

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OBITUARIES

Professor Anneke Clason
(1932-2008)

I first met Dr. Clason, a one of the leading archaeozoologists of the world in November 1970 at her Institute in Gröningen. She was extremely friendly, and a very soft spoken, warm and friendly person. She took me in her car to Leiden to enable me to see the *Pithecanthropus* fossils brought from Java. At that time Dr. P.K. Thomas had just begun his Ph.D. work on osteological material from Bagor. We hardly had any laboratory facilities at that time. I approached Dr. Clason to visit to the Deccan College for helping us in establishing an Archaeozoology Lab and providing guidance to Dr. Thomas. She spontaneously agreed to my request. She told me that she would come to Deccan College on her own and would not need any financial help except free accommodation. I also spoke to Prof. Waterbolk, then Director of her Institute, and he readily agreed to permit her to accept my invitation.

On my return to Pune I apprised Prof. Sankalia about this matter, and he promptly agreed to provide free accommodation to Dr. Clason in the furnished guest house of the American Institute. Accordingly, Dr. Clason came to Pune the next year and helped us in collecting carcasses of animals from different places, including the abandoned stone quarry behind

Tingre Nagar, bury them in the Department's campus and clean them. I provided a stove to Dr. Thomas to boil water for cleaning the bones (there was no gas in those days). Dr. Thomas worked hard in preparing the bones under her guidance. During her stay with us Dr. Clason studied all the faunal available material and also studied already published material. She prepared a monograph on the prehistoric and early historic fauna of India which I was able to get published by the Ethnographic and Folk Culture Society, Lucknow. Dr. Clason's contribution to establishing the Archaeozoological studies at the Deccan College is very important and will always be gratefully remembered.

Later I met Dr. Clason again at several international conferences, like the IX conference of Prehistoric and Protohistoric Sciences at Nice in 1976, conference of the Anthropological and Ethnological Sciences at Quebec and Vancouver in Canada in 1983. If I remember right, she also came to Deccan College again for the IPPA symposium on Recent Advances in Indo-Pacific Prehistory in 1978.

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Professor Anneke Clason was born in 1932 and grew up in Java. After Japanese occupation of Java in 1941 she and her family members were interned in a war camp. She became the successor to Prof. A. E. van Giffen at the Biological-Archaeological Institute, Gröningen in 1959. She was a co-founder of the International Council for Archaeozoology (ICAZ). In 1974 she organised the first international conference of archaeozoology. She took active interest in the proceedings of ICAZ helped the organisation grow. It was due to her sustained efforts on international level that animal remains came to be regarded as an important part of archaeological research. In 1994 her efforts in bringing archaeozoology to the forefront were recognised when she was made a Professor of Archaeozoology. She was instrumental in educating generations of professional archaeozoologists across the world.

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* The editors thank Dr. W. Prummel, a former colleague of Prof. Clason for providing her photograph and list of her publications.

Prof. Clason at the Deccan College

My interaction with Prof. Clason began in 1990 when my teacher Dr. P.K. Thomas and his teacher Prof. V.N. Misra encouraged me to visit her institute in Gröningen. At that time I was about to complete my doctoral dissertation. In those days our Archaeozoology Lab did not have adequate collection of bird bones. The idea behind this visit was to get her guidance in developing bird osteology. She was very helpful and always gave me a motherly treatment. Under her critical supervision, I prepared bird identification keys that are still useful to me in my studies. My topic of using statistical and mathematical techniques in faunal studies was then relatively new in Indian archaeology. My visit to Prof. Clason proved to be a golden opportunity since I could get access to her vast collection of dissertations. In her collection, she had, in those days, more than 300 dissertations in archaeozoology across the world in many languages. Since I was able to read German and Dutch to some extent, I could utilise these dissertations and get to know many news ideas for refining my biostatistical methodology. During my stay at Gröningen and later until a couple of years ago she always helped me in many ways. She made it a point to take me to various museums and introduced me to many Dutch and Belgian archaeozoologists. I had an interest in World War II in those days. She took me to many war memorials and concentration camps. I learnt it later that she disliked such things because of her horrific childhood experiences in Indonesia. But she never told me anything of this in those days and on weekends arranged for my visits. On one occasion while visiting a POW camp where Gröningen University scholars were interned, she became emotional and very proudly saluted those Dutch martyrs.

She had a deep affectionate relationship with our institution. From time to time Dr. Thomas and our younger colleagues Drs. Arati Deshpande-Mukherjee and Seema Pawankar also had a warm interaction with her. All of us at the Deccan College Archaeozoology Laboratory, who are proud to be students of her 'Gröningen School of Archaezoology', regret her sad demise.

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Report of the General Secretary for 2007-2008
(01-04-2007 to 31-03-2008)

The functioning of the Society during the year ending on 31-3-2008 has been satisfactory, both academically and financially. The regular activities of the Society were carried out successfully. The financial position is reasonably sound because of the interest accruing on the fixed deposits and annual grant for publication of the Society's Journal *Man and Environment* as well grants for organizing the annual conference from the Indian Council of Historical Research (ICHR) and Archaeological Survey of India (ASI). We are grateful to ICHR and ASI for financial support. The audited statement of accounts for the period ending 31-03-2008 is printed in this Volume 33 (2).

Man and Environment

This is the thirty-second year of the publication of the Journal and twentieth year of its biannual publication. The Journal has maintained its standard and continues to attract a wide range of manuscripts by scholars from within and outside the country. The circulation of the journal is steadily increasing.

We sincerely thank Mr. Sujit Patwardhan and his staff of Mudra Press, Pune for their excellent cooperation in the production of the Journal.

XXXV Annual Conference

The 35th Annual Conference was held, in conjunction with the 41st Annual Conference of the Indian Archaeological Society and 31st Annual Conference of the Indian History and Culture Society from 1st to 4th December 2007. It was organized by the Directorate of Culture and Archaeology, Government of Chhattisgarh at Raipur.

The following life members of the Society participated in the conference: S.R. Adhyapak, P.Ajithprasad, R.K. Bansal, Kanchana Bhaisare, Ms. Bina Gandhi Deori, Dharmendra Bahadur, K.N. Dikshit, , A.S. Gaur, Vijay Gedam, M.C. Gupta, P.P. Joglekar, P.S. Joshi, J.P. Joshi, Ismail Kellelu, V.D. Misra, R.K. Mohanty, Ramesh K. Panchoi, J.N. Pal, Archana Pataskar, Narendra Pitale, S. Prapatchandran , L.S. Rao, Fariba Sarhaddi, N.K. Sinha, K.S. Saraswat, Chanchala Srivastava, D.K. Srivastava, R.K. Srivastava, Tilok Thakuria, Sila Tripati, Vibha Tripathi, D.P. Tewari, V.H. Sonawane, A. Sundara and P.K. Thomas.

Inaugural Function

The inaugural function of the joint Annual Conference of the three Societies was held on 1st December, 2007. The programme stared with *Saraswati Vandana* and Dr. A.K. Sharma, the chief organizing secretary of this Conference welcomed all the guests. Dr. R.C. Tripathi, Shri J.P. Joshi, Shri K.N. Dikshit, Prof. A. Sundara, Prof. Vibha Tripathi and Shri Rakesh Chaturvedi were on the dais. Homage was paid to departed scholars – Dr. S.P. Gupta, Shri M.C. Joshi and Dr. Sita Ram Sharma.

Presidential Address

The Presidential Address of the Society was delivered by Professor A. Sundara, Former Head of the Department of Ancient History, Culture and Archaeology, Karnataka University, Dharwad. He spoke on "South Indian Protohistoric Archaeology: Some Problems".

Professor H. D. Sankalia Memorial Lecture

The seventieth Professor H.D. Sankalia Memorial Lecture was delivered by Professor V.H. Sonawane, Former Head of the Department Archaeology and Ancient History, the Maharaja Sayajirao University of Baroda. The title of his lecture was "Rock Art of India: A Historical Perspective". This lecture has been printed in Volume 33 (1).

R.K. Sharma Award for Excellence in Archaeology

This year, the R.K. Sharma Award for Excellence in Archaeology was conferred upon veteran archaeologist Shri J. P. Joshi (who is no more with us). Late Shri J. P. Joshi in his career that spanned over four decades has contributed immensely to growth of India's archaeological past.

Dr. Malti Nagar Ethnoarchaeology Award

This year's Dr. Malti Nagar Ethnoarchaeology Award was given to Mr. Rammathot Khongreiwo, Department of History, University of Delhi for his paper "Tangkhul Naga Megalithic Tradition: A Case Study of North Ukhrul, Manipur". A modified version of this paper has been printed in Volume 33 (1).

The Academic Sessions

The academic sessions of the conference were held from 1-4 December 2007 and the following papers were presented.

Author/s	**Title of the paper**
L.S. Rao	Evolution of Harappan Bullock Cart at Bhırrana, District Fatehabad, Haryana.
S.G. Deo, Sheila Mishra, Riza Abbas and Gurudas Shete	Recent Excavations at the Acheulian Site of Morgaon, District Pune, Maharashtra

Ismail Kellellu, P.S. Meshram and B.S. Gajbhiye	Excavation at Gaurala, District Chandrapur, Maharashtra
Tilok Thakuria and R.K. Mohanty	Annihilation of Archaeological Sites: A Case study of Megalithic Vidarbha, Maharashtra.
P.S. Joshi	Megalithic Culture of Early Iron Age in India: New Trends.
Pratapchandran S.	Magan Melluha – Their Trade Relations
P. Ajithprasad, S.V. Rajesh and B.P. Sharma	The Prabhas Assemblage and the Recent Exploration in the Saurashtra Coast of Gujarat.
Pankaj Goyal and P.P. Joglekar	A Few Observations on the Faunal Remains from Kanmer, Gujarat
Arati Deshpande-Mukherjee, P.K. Trivedi and J.K. Patnaik	Faunal Remains from Tarkhanewala Dera and Chak 86, District Ganganagar, Rajasthan
Chanchala Srivastava	Emerging Trends of Palaeo Ethnobotanical Investigations at Ancient Indor-khera, District Bulandshahr, U.P.
K.S. Saraswat	Plant Economy at Ancient Imlidih – Khurd in the context of the Middle Ganga Plain
Ramesh K. Pancholi Bina Gandhi Deori and R.K. Bansal	"Kritya hi Kala" Political Marriage Alliances
R.K. Bansal and Bina Gandhi Deori	Oxen and Carts: Common Means of Transportation in the Mughal Period
R.K. Mohanty and Monica Smith	Sisupalgarh Excavations- 2007.
Rama Kant	Upper Palaeolithic Culture of North-Central India
Dharmendra Bahadur	Stone Tools: A Functional Analysis
V.D. Misra, J.N. Pal and M.C. Gupta	Chronology of the Neolithic Culture of the Ganga and the Vindhyas

New Life Members

The following persons joined the family of life members of the Society during 2007-2008: Kaushik.Gangopadhya, Vijaya.Gedam, Varada Khaladkar, Chumbeno Ngulle, Narendra Pitale, Monica Smith, D.K Srivastava, Tilok Thakuria and Akumla Walling.

Meeting of the Executive Committee

A meeting of the Executive Committee of the Society was held on 3rd December 2007. The meeting was presided over by Prof. V.H. Sonawane. Since the quorum was not fulfilled after 30 minutes the meeting took place and following members were present.

1. Dr. P.K. Thomas, 2. Dr. P.P. Joglekar, 3. Dr. K. Ismail, 4. Prof. V.H. Sonawane, and 5. Dr. A.S. Gaur

Matters related to functioning of the Society were discussed. Dr. P.K. Thomas, General Secretary appraised the members of the activities of the Society during 2006-2007 and presented an audited statement of accounts for 2006-2007. The audited statement was accepted after a discussion and the meeting ended with a vote of thanks to the Chair.

Meeting of the General Body of the Society

The General body meeting of the Society was held on 4th December 2007 at 3.30 pm. The meeting was presided over by Professor A. Sundara, President of the Society for 2007-2008. The following members were present.

S.R. Adhyapak, P.Ajithprasad, R.K. Bansal, Kanchana Bhaisare, Ms. Bina Gandhi Deori, Dharmendra Bahadur, K.N. Dikshit, , A.S. Gaur, Vijay Gedam, M.C. Gupta, P.P. Joglekar, P.S. Joshi, J.P. Joshi, Ismail Kellelu, V.D. Misra, R.K. Mohanty, Ramesh K. Panchoi, J.N. Pal, Archana Pataskar, Narendra Pitale, S. Prapatchandran , L.S. Rao, Fariba Sarhaddi, N.K. Sinha, K.S. Saraswat, Chanchala Srivastava, R.K. Srivastava, Tilok Thakuria, Sila Tripati, Vibha Tripathi, D.P. Tewari, V.H. Sonawane, A. Sundara and P.K. Thomas.

The following business was transacted at the meeting.

The General Secretary, Dr. P.K. Thomas, welcomed the members and presented the report of the activities of the Society for the year 2006-2007. The members of the Society unanimously approved it. The General Secretary placed the Annual Audited Statement of the Accounts for the year 2006-2007 before the General Body, and the members present unanimously approved it. All the members present in the meeting expressed their pleasure and thanked Dr. A.K. Sharma, the chief organizing secretary for excellent arrangements of the Conference. The meeting passed a resolution to thank the Directorate of Culture and Archaeology, Government of Chhattisgarh.

President of the Society for 2008

Dr. P.K. Thomas proposed the name of Prof. S. Nagaraju as President of the Society for the next year. The proposal was unanimously accepted by the members present.

Professor H.D. Sankalia Memorial Lecturer for 2008

Prof. V.H. Sonawane proposed the name of Dr. K.S. Saraswat, former scientist of the Birbal Sahani Institute of Palaeobotany, Lucknow for the Prof. H. D. Sankalia Memorial Lecture for 2008. The members present unanimously approved the proposal.

P.K. Thomas 25-11-2008
General Secretary

THE BOMBAY PUBLIC TRUST ACT, 1950. - SCHEDULE IX (VIDE RULE 17 (1)
INDIAN SOCIETY FOR PREHISTORIC AND QUATERENARY STUDIES
C/O - DEPARTMENT OF ARCHAEOLOGY, DECCAN COLLEGE, PUNE - 411 006

BALANCE SHEET AS ON 31ST MARCH, 2008
REGN - GUJ - 508 - AHEMADABAD

Funds & Liabilities	**Rs.**	**Rs.**	**Property & Assets**	**Rs.**	**Rs.**
Trust Funds or Corpus			**Immovable Properties**		42,734.00
Bal. as per Prev. B/S.	656,108.52		- Computer System	20,927.00	
Adjustment during the year			- Cupboards	7,704.00	
(Donations recd. during the year)	0.00		- Dead Stock	846.00	
		656,108.52	- Fan Parchase	216.00	
			- Furniture & Fixtures	13,041.00	
(Created under the provisions of the trust deed or scheme or out of the income)			**Investments**		1,898,383.44
Depreciation Fund			(AS PER SCHEDULE II)		
Reserve Fund	1,361,687.77				
Other Earmarked Fund	83,607.95	1,445,295.72	**Other Movable Properties**		0.00
			Current Assets		
For Expenses	0.00		- Sundry Debtors	6,522.00	6,522.00
Other Deposits	0.00		**Cash & Bank Balances**		
Audit fee PROVISION FOR	4,720.00		- Cash		1,611.77
Amt. Payable	0.00		- Bank Balances	278,596.97	280,208.74
Other Liabilities	788.94	5,508.94			
Income & Expenditure A/c.			**Income & Expenditure A/c.**		
Bal. as per prev.B/S.	0.00		Bal. as per prev.B/S.		
Less : Appropriation if any	0.00		Add: Deficit for the year		
Add : Surplus of Inc & Exp A/c	120,935.00				
Less : Trf to General Reserves	0.00	120,935.00			
Total Rs.		**2,227,848.18**	**Total Rs.**		**2,227,848.18**

As per our report of even date
For **A.S. CHANDVANKAR & CO.**
Chartered Accountants

(A.S. CANDVANKAR) Proprietor	General Secretary	Joint Secretary	Treasurer
M.No.: 043811	Place : Pune	Date : 25 November 2008	

THE BOMBAY PUBLIC TRUST ACT, 1950. - SCHEDULE IX (VIDE RULE 17 (1)
INDIAN SOCIETY FOR PREHISTORIC AND QUATERENARY STUDIES
C/O - DEPARTMENT OF ARCHAEOLOGY, DECCAN COLLEGE, PUNE - 411 006

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2008

REGN - GUJ - 508 - AHEMADABAD

	Expenditure	**Rs.**	**Rs.**		**Income**	**Rs.**	**Rs.**
To	Expenditure in respect of			By	Rent (accured/realised)		0.00
	Repairs & Maintenance	0.00	0.00				
				By	Interest (accured/realised)		
					On Deposits (FD)	0.00	
					On Bank Account	7,007.00	7,007.00
To	Expenditure on the object of the Trust			By	Grants From ICHR		131,750.00
	(as per schedule - A)						
	Conference Expenses	67,162.00		By	Donation		100,000.00
	Publication Expenses	194,526.00					
	Other Expenses	3,926.00	265,614.00	By	Cost of Monographs - DHP ETC		6,345.00
To	Contribution and Fees		0.00	By	Life Membership Fees		28,000.00
To	Depreciation		33,813.00	By	Sale of M & E Volume		147,260.00
To	Surplus carried over to B/s		120,935.00	By	Deficit Carried over to B/s		
	Total Rs.		**420,362.00**		**Total Rs.**		**420,362.00**

As per our report of even date
For **A.S. CHANDVANKAR & CO.**
Chartered Accountants

(A.S. CANDVANKAR) Proprietor	General Secretary	Joint Secretary	Treasurer
M.No.: 043811	Place : Pune	Date : 25 November 2008	

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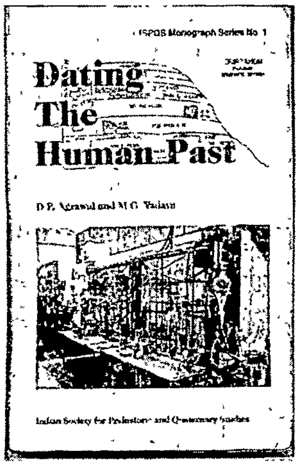

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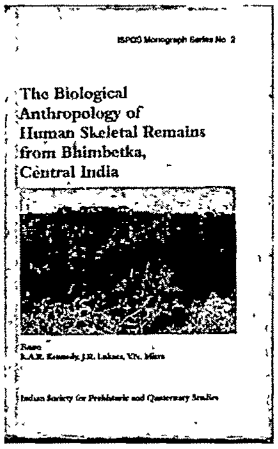

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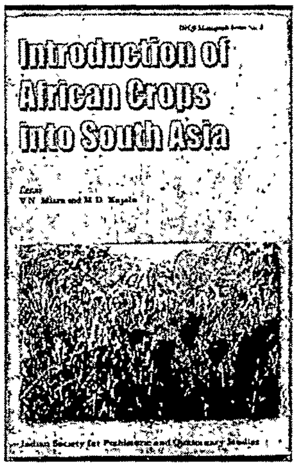

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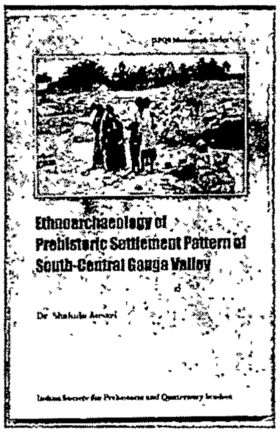

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  ISPQS
  C/o Department of Archaeology, Deccan College, Pune 411 006

Fig. 1: Dr. A.K. Sharma welcoming the delegates during the inaugural function

Fig. 2: Prof. A. Sundara delivering Presidential Address

Fig. 3: Prof. V.H. Sonawane delivering Prof. H.D. Sankalia Memorial Lecture

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